NATURE

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The Promotion of Peace

THE agreement arrived at by the four-power conference, which met at Munich on September 30 to find a peaceful solution of the conflicting rights of Czechs and Germans to territory assigned to Czechoslovakia by peace treaties which followed the Great War, marks the beginning of a new era in the history of the world, and will be gratefully welcomed by scientific workers in natural and national fields as a significant stage in the progressive ethical evolution of the human race.

The British people have expressed their enthusiastic admiration for the self-sacrifice and unceasing endeavour exercised by Mr. Neville Chamberlain, the Prime Minister, to secure this end. Suggestions have been made that a national tribute fund should be opened, and Sir Charles Hyde has put at the disposal of the University of Birmingham the sum of £10,000 to provide a Neville Chamberlain fund or scholarship. Appropriate recognition, independent of nationality, could be given by the Nobel peace prize, which is awarded "to the person who shall have most or best promoted the fraternity of nations and the abolition or dissemination of standing armies and increase of peace congresses".

The immediate object of the meeting between Mr. Chamberlain, M. Daladier, Herr Hitler and Signor Mussolini, reinforced by letters from President Roosevelt, was to find a peaceable settlement of a bitter dispute between Czechs and Germans; and though the people of Czechoslovakia naturally regard the terms imposed upon them as harsh, they and other nations would suffer far more if active hostilities had eventually to determine them. Even more important than the agreement of the four great European powers as to new boundaries between Germany and Czechoslovakia was the declaration signed by Mr. Chamberlain and Herr Hitler as the result of a further talk.

"We regard," it says, "the agreement signed last night and the Anglo-German Naval Agreement as symbolic of the desire of our two peoples never to go to war with one another again. We are resolved that the method of consultation shall be the method adopted to deal with any other questions that may concern our two countries, and we are determined to continue our efforts to remove possible sources of difference and thus to contribute to assure the peace of Europe."

This is, indeed, a step forward in the promotion of peaceful methods of settling disputes between nations; and however much we may deplore the intolerance of intellectual freedom, and the persecution of a defenceless minority, by which Germany is suppressing the advancement of knowledge and the rights of man, the declaration of the new Anglo-German undertaking makes the outlook much brighter. Sixty years ago, another Prime Minister, Disraeli, avoided a war between Russia and Britain by the Treaty of Berlin, as the result of consultation with the councils of Europe, and secured his "peace with honour". We hope and believe that the resolution now made between the German Führer and Chancellor and the British Prime Minister will have more lasting influence than that reached by Disraeli, of whose treaty it was said soon afterwards:

"Once 'peace with honour' home was brought;
And there the glory ceases.
For peace a dozen wars has fought,
And honour's all to pieces."

The Cyclotron and its Applications*

By Prof. J. Chadwick, F.R.S.

IN the early work on the artificial disintegration of elements by α-particles, it was thought that particles of very high energy were necessary in order to penetrate the nuclei of even the lighter elements, and there appeared little, if any, hope of ever extending these experiments to the heavy elements.

The application of quantum mechanics to the problem of the penetration of potential barriers, however, indicated that particles of comparatively low energy should have a small, but not negligible, probability of entering the nuclei of the light elements. Now the small chance of penetration can be compensated by using large numbers of particles, and Cockcroft and Walton realized that this might make it possible to observe disintegrations with particles of energy of only a few hundred kilovolts. They carried out the first successful experiment of this kind in 1932, when they observed the disintegration of lithium under the bombardment of protons. Using potentials up to 600 kv. to accelerate the ions obtained from a hydrogen discharge tube, they were able to disintegrate several of the lighter elements. They were, however, unable to produce disintegrations in the heavier elements. The reason for this limitation is that the height of the nuclear barrier opposing the entry of the proton increases with the atomic number of the element. In order to disintegrate the heavy elements, we must use particles of much greater energy than those used by Cockcroft and Walton. In fact, we require accelerating voltages of some millions of volts instead of some hundred thousands.

During the last ten years, several methods have been developed for accelerating ions—protons, deuterons or α-particles—to the very high energies necessary for these experiments on the transmutation of elements. The methods may be divided into two classes, the direct methods, in which a high voltage is developed and applied to a discharge tube, and the indirect methods. The direct methods have some serious disadvantages. First, they are limited to what for the present purpose are moderate voltages. Experimental difficulties increase rapidly as the voltage is increased, and so far the highest voltage which has been used directly for the acceleration of ions is two million volts. Secondly, high-voltage outfits need much space. The cost of installing an outfit operating at, say, 5 million volts, would be very high for the building alone, for few, if any, physical laboratories possess the large and lofty hall which is necessary to house such an apparatus.

In the indirect methods of accelerating ions, a relatively small voltage is applied many times in succession, increasing the energy of the particles in a series of small steps.

The most successful of these indirect methods is that used in the cyclotron, or magnetic resonance accelerator, which has been developed by Prof. E. O. Lawrence and his collaborators in the University of California.

Suppose a particle of mass m and charge e moves with velocity v in a plane at right angles to a magnetic field H. The particle will move in a circular path of radius ρ where ρ is given by

$$mv^2/\rho = H e v$$

The time taken to complete a revolution is

$$\frac{2\pi\rho}{v} = 2\pi.\frac{m}{e}.\frac{1}{H}$$

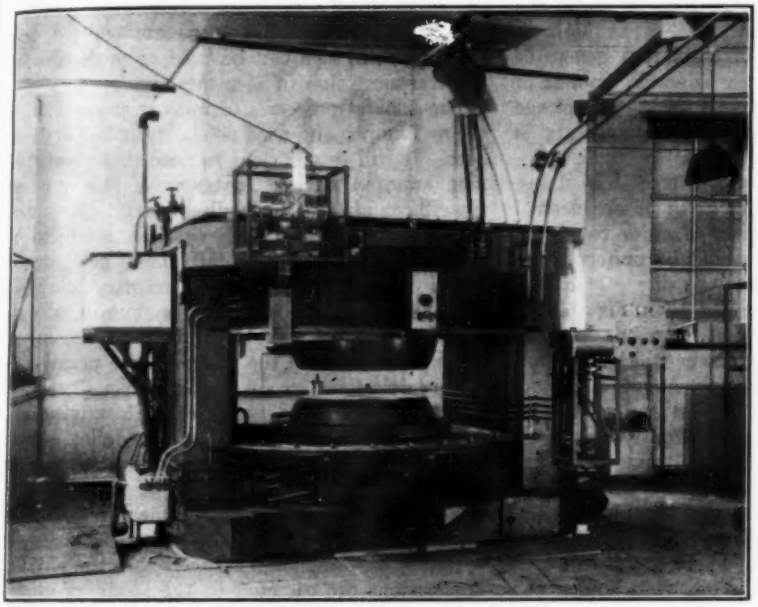
The time of revolution does not depend on the radius of the path or on the velocity of the particle. For ions of the same e/m, the time of revolution will always be the same in the same field.

Now suppose that we have in the field two electrodes between which we can apply an alternating voltage, V. Let an ion start with very small velocity at some point between the electrodes. If the top electrode happens to be positive at that moment, the ion will be driven downwards. It will travel in a semi-circular path and return to the gap between the electrodes. Its energy will be eV. If at this moment the top electrode is negative, it will be driven upwards, acquiring another increment of energy eV. Since the particle always takes the same time to go round the semi-circle and return to the gap, it should be possible by adjusting the frequency of the A.C. voltage and the strength of the magnetic field to keep in step with the particle, that is, to give the particle an impulse every time it crosses the electrodes.

Whether this method is possible in practice will depend first on whether one can produce oscillating voltages of the required frequency. Let us calculate what frequency is required for a proton.

* From the Friday evening discourse given at the Royal Institution on May 27.

The time of rotation is $2\pi.\frac{m}{e}.\frac{1}{H}$, and for a proton is equal to $6{\cdot}57 \times 10^{-4}/H$ sec. The final velocity of the proton is proportional to $H\rho$, where ρ is the radius of its final orbit. Since it is desirable to keep the dimensions of the apparatus—and especially the dimensions of the magnet—as small as possible, H must be large. With good mild steel, H may be as much as 19,000–20,000 gauss. Let us take H equal to 15,000 gauss as a readily attainable strength of field. Then the time of rotation is $4{\cdot}38 \times 10^{-8}$ sec. The frequency of the alternating field must therefore be $2{\cdot}28 \times 10^{7}$ cycles per sec., corresponding to a wave-length of about 13 metres.



Magnet of the Liverpool cyclotron

The photograph, taken at an early stage in the construction of the cyclotron, shows the magnet assembly with its water supplies, etc., but without the vacuum chamber and its auxiliaries

As the time of rotation is proportional to m/e, the frequencies of the oscillations required to accelerate deuterons or helium ions (α-particles) under the same conditions will be half as great, corresponding to a wave-length of 26 metres.

We have now to calculate what speeds the particles can acquire in this way. The maximum velocity is determined by $H\rho$, that is, it depends not only on the strength of the field but also on its extent. In the magnet at Liverpool the diameters of the pole faces are 94 cm., and we can allow ρ to be about 38 cm. With H equal to 15,000 gauss, the proton would reach a speed of $5{\cdot}4 \times 10^{9}$ cm./sec., or an energy of 15 million volts. Under corresponding conditions, deuterons would acquire an energy of 8 million volts.

At first sight it seems that exceedingly high energies might be reached, for it is quite feasible to increase H to 20,000 gauss and ρ to 60 cm. or more. A proton of $H\rho$ equal to $1{\cdot}2 \times 10^{9}$ would have an energy of about 60 million volts. However, a serious difficulty appears when the protons move at a speed corresponding to more than about 10 million volts (deuterons at about 15 million volts). This difficulty arises from the relativity increase of mass of a particle with its speed. The relation $H\rho = mv/e$ is no longer sufficiently precise, and we must write

$$H\rho = \frac{m}{e}.\frac{v}{\sqrt{1-v^2/c^2}}.$$

The particle will not keep in step with the electrical oscillations, that is, there will not be resonance. One could try to obtain exact resonance by adjusting the magnetic field so that it increases gradually as ρ increases, but this introduces another defect which may result in complete loss of the ion beam. It may prove possible to find a suitable device to overcome these troubles, but at the present moment it seems that limits are set to the energies which it is feasible to reach, about 10 million volts for protons, 15 million volts for deuterons and α-particles. Even these limits have not yet been quite attained.

The possibilities of the cyclotron are so outstanding that, in spite of the expense and labour of construction, many machines have been or are being built in laboratories all over the world. In Great Britain there are two cyclotrons nearly ready for use, one in Cambridge and the other in Liverpool. It may be of interest to give a few details of the construction of the Liverpool cyclotron, although it is not yet in operation.

The electrodes between which the ions are accelerated are two short, hollow semi-cylinders of large diameter, about 2 inches high and about

30 inches diameter, made of copper sheet. These, known as the *D* plates, are contained in a large chamber or tank. Hydrogen (for a proton beam), or heavy hydrogen (for deuterons) is admitted to the tank, so that a pressure of about 10^{-4} mm. is maintained.

The ions are produced at the centre of the chamber, between the *D* electrodes, by bombarding the gas with an intense stream of electrons from a heated filament.

The alternating voltage is applied to the *D*'s by coupling them to an oscillating circuit. The generator of the oscillations consists of two large triode valves coupled in push-pull, using a self-oscillating circuit. It is important to make the voltage difference between the *D*'s as high as possible, and therefore the oscillation generator must be able to supply a considerable amount of power, certainly more than 20 kw. The voltage between the *D*'s in Lawrence's experiments is about 45,000 volts.

The vacuum chamber, containing the *D* plates, etc., is placed between the poles of an electromagnet. As it is important, in order to obtain resonance, that the field should be uniform over the whole path of the ions, the diameter of the poles must be sensibly greater than that of the *D* plates. The magnet must therefore be very large, and a fair amount of power will be required to maintain the magnetic field. Our Liverpool magnet contains 46 tons of iron and 8 tons of copper. (The copper was generously presented to me by the directors of British Insulated Cables, Ltd.). The diameter of the pole faces is about 36 inches and the air gap between them is 8 inches. The power consumption in normal running conditions will be from 40 to 50 kw., under full load about 70 kw. The maximum field under the conditions of experiment, that is, with a working gap of 5 inches, is about 19,000 gauss.

When the ions come to the periphery of one of the *D*'s, they are allowed to pass through an opening where the *D* is cut away. An electric field is applied between a plate—the deflector plate—and the *D* to deflect them from their circular path towards a window in the tank. The ions can thus be brought out of the tank and made more readily available for experiment.

The intensity of the ion beam which is obtained in this way depends of course on the number of ions produced initially at the centre of the chamber. It depends also on a very careful adjustment of the magnetic field, by means of which the ions are concentrated near the median plane of the *D* plate. In Lawrence's early experiments the ion current was of the order of 0·01 microampere. Now, by improvement of the conditions, Lawrence can maintain an ion current of 150 microamperes for many hours. The number of particles carried by such a current is 10^{15} per second, equal to the number of α-particles emitted by 30 kgm. of radium. Moreover, the energy of the particles is greater—about 8 million volts—nearly double the energy of the fastest α-particle from radioactive bodies.

The Applications

When the stream of fast particles—protons, deuterons, or α-particles—issuing from the cyclotron is allowed to fall on a target of an element, some of the atomic nuclei may undergo transmutation. The incident particle enters the nucleus and a new nucleus is formed which disintegrates with the emission of a different particle. In many of these transmutations, neutrons are emitted, and these in their turn can be used as projectiles for the transmutation of elements.

The general processes of nuclear transmutation are well known and need not be described in detail here. It will be sufficient to note that more than four hundred nuclear reactions of this primary type have already been discovered. Many new forms of atomic nuclei have been produced in these reactions. Nearly all these new atomic nuclei are isotopes of the ordinary chemical elements. They differ from the known isotopes in that they are unstable and transform, in the course of time, with the emission of a negative or positive electron into a stable nucleus. This is the phenomenon of artificial radioactivity discovered by Mme. and M. Curie-Joliot. Such changes as these may be called secondary nuclear reactions. About two hundred or more cases of this type are known, some of which are of special interest.

In general terms, one may say that the physical applications are directed to the study of atomic nuclei, their transmutation by bombardment with different nuclei, the investigation of the properties of neutrons and of the interaction of fast particles with matter.

I should like, however, to refer to certain applications of the cyclotron which depend on these nuclear reactions, and in particular to the biological applications.

One may draw an analogy between the cyclotron and the X-ray tube. In the X-ray tube the stream of electrons is used to produce X-rays; the fast ions issuing from the cyclotron can be used, by bombarding beryllium for example, to produce a stream of neutrons. When we remember the uses of X-rays and of radium in the treatment of malignant tissues, it is natural to ask what are the possible applications of neutrons.

The ionizing effects of neutrons are rather different from those of X-rays. The X-rays impart their energy to the electrons of matter

through which they pass, and these secondary electrons produce relatively small ionization over a long path. Neutrons do not lose energy in collision with electrons but in collision with the nuclei of atoms. In passing through living matter, neutrons will lose energy mainly in colliding with the hydrogen atoms, producing recoil protons which ionize very strongly over a short path. For example, 2 M.e.v. neutrons passing through tissues will frequently produce recoil protons of about 300,000 volts energy. These will produce about 10,000 ions in a distance of some 4–5μ. A secondary electron produced by X-rays would give less than 100 ions in the same path.

It seems that biological effects on individual cells depend more on ionization density than on the total number of ions, and therefore one might expect that neutrons will be biologically more effective than X-rays giving the same total ionization. There is a certain amount of evidence which indicates that this is indeed the case, but the results are too meagre to permit a definite conclusion. For a given ionization, neutrons appear to be about five times as effective as X-rays in destroying malignant cells or in changing the blood picture of the rat, and about ten times as effective in retarding the growth of wheat seedlings. Many experiments are now in progress both on plant and on animal tissues.

By means of neutron irradiation it may be possible to produce biological effects in specific regions. There are some elements which show strong absorption of slow neutrons, for example, lithium and boron. Ordinarily, animal tissues do not contain any significant amount of these elements, but it may prove possible to inject into the tissues in a suitable form compounds of such elements. Irradiation of the tissues with slow neutrons would then cause the release of considerable energy in the small volume containing the injected substance.

Radioactive Indicators

Another aspect of the application of the cyclotron to biological investigations arises from its use in the production of artificial radioactive elements. Nearly all the ordinary chemical elements can now be obtained in radioactive modifications. These have exactly the same chemical properties as the usual forms. The radioactive isotope will accompany its inactive isotope through any series of chemical processes, however complicated these may be; but the active isotope can always be recognized by its radioactivity, which acts as a label enabling us to detect the presence of a particular group of atoms and to follow this group throughout the chemical processes. Thus, if we wish to study the distribution of a certain element in a series of biological processes, we can mix with it a radioactive isotope, and we can follow the distribution by means of the radioactivity.

Up to the present, the use of active indicators in biological investigations has been almost entirely confined to the role of phosphorus in metabolism. Apart from its structural function along with calcium as a major constituent of bones and teeth, phosphorus, as phosphoric acid, plays a predominant part in the intermediate metabolism of a variety of substances. An active modification of phosphorus can be produced in different ways, one of which is the deuteron bombardment of phosphorus:

$$^{31}_{15}\mathrm{P} + ^{2}_{1}\mathrm{H} \rightarrow ^{32}_{15}\mathrm{P} + ^{1}_{1}\mathrm{H}$$
$$^{32}_{15}\mathrm{P} \rightarrow ^{32}_{16}\mathrm{S} + ^{0}_{-1}e$$

The radio-phosphorus breaks up with the emission of a β-particle and the formation of ^{32}S. It decays to half value in 14½ days, a very convenient period.

Radio-phosphorus was first used as an indicator by Chiewitz and Hevesy in the study of phosphorus metabolism in rats. The active phosphorus is mixed with inactive phosphorus and converted into sodium phosphate. This can be mixed with the food of the rat. The fate of the phosphorus—whether excretion, deposition, transfer from one tissue to another, and the biological synthesis of compounds which contain phosphorus—can then be followed by tracing the radioactive atoms.

In this way it was found that a large part of the phosphorus was incorporated in various compounds in the bones and muscles, from which it is gradually displaced. The experiments confirm the idea that the mineral matter of bone is in a dynamic state, in which the bones are continually losing phosphorus atoms and taking up others which are later, in their turn, replaced.

Another example of the use of phosphorus is given by an experiment of Hahn and Hevesy. It is generally assumed that no regeneration of the brain tissue of adult animals takes place. Hahn and Hevesy found, however, that one hour after a subcutaneous injection of labelled sodium phosphate, labelled lecithin was already formed in the brain tissue of fully grown rats. Their experiments suggest that a constant breakdown and building up of lecithin takes place in the brain tissue.

These examples are sufficient to show that by the use of radio-phosphorus as an indicator it is possible to provide a ready answer to such questions as: How much of the phosphorus taken in by the body at a given moment reaches the bones or teeth? How long does it take to arrive there?

By what path does it arrive? How long does it stay? How does the distribution of phosphorus depend on abnormal conditions of diet or disease?

Investigations such as these are now beginning in various laboratories. They will not be restricted to the study of phosphorus, for other elements of interest in bodily metabolism such as calcium, potassium, iron, etc., are available in active modifications. I think it is clear that this method of radioactive indicators has many interesting possibilities, for its power and delicacy make it possible to attack problems which have so far been inaccessible to experiment.

There are also other applications of the radioactive modifications of suitable elements. If an element is concentrated in certain organs, then these organs can be subjected to selective irradiation by using an active isotope of the element. For example, radio-phosphorus can be used to irradiate bone and bone marrow, or spleen; radio-iodine for thyroid, etc. So little work has been done on these lines that it would be premature to discuss these therapeutic applications further. They may, however, prove to be important and among the most spectacular results of experiments on artificial transmutation.

History of the Fenland*

WITHIN historic times, the English fenland stretched over the greater part of the area to the west and south of the Wash, extending as far north as Lincoln and as far south as Huntingdon and Cambridge. On the seaward side, the surface deposits are semi-marine silts, laid down, and afterwards occupied, during the Romano-British period. On the landward side, the upper layers are peat produced by discharge of the flood waters of the Rivers Witham, Welland, Nene and Ouse into the extensive shallow basin of the fens. The fen peats are alkaline and therefore support a vegetation of the true 'fen' type. Very little of the original vegetation of the peat fen remains, however, since the whole area has been drained and brought under extensive cultivation. Its present characteristics are the black peaty soil, uniform flatness and deep ditches full of reeds (*Phragmites communis*) which separate fields of cereals, potatoes and sugar beet.

Cambridge is at the head of the fens, and the town and University have become the centre of the activities of the Fenland Research Committee, formed in 1932 under the presidency of Sir Albert Seward, and aided by grants from the British Association, the Percy Sladen Trust and the Department of Scientific and Industrial Research. Thus have the geology, botany, archæology, stratigraphy and climate of the fenland area been closely investigated. One fen area which has yielded exceptionally valuable results is Wicken Fen, the largest area still uncultivated, covering about one square mile, now in the hands of the National Trust, and lying about ten miles to the north-east of Cambridge on the margin of the fenland itself.

* Based on the evening discourse by Dr. H. Godwin to the British Association at Cambridge on August 19.

Very little is known of the fenland in glacial times; for most of our knowledge of the area we must turn to the post-glacial period, during which the most important single key to its history lies in the recognition of the land- and sea-level movements which have left their record in the deposits of the basin.

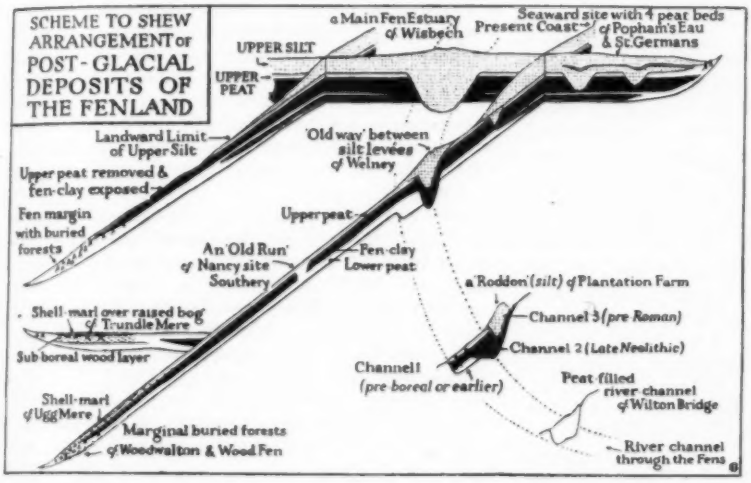
The upper layers are very similar to those of the German coastal marshes. Although the peat is continuous at the margin, it is soon separated into an upper and lower layer by wedging out of soft grey clay. The lower layer contains brushwood of oak, pine and alder; the upper layer contains some tree remains and above this a layer of *Sphagnum* peat of a type similar to that of the large red bogs of the central Irish plain. In certain parts there is a layer of calcareous shell-marl overlying the *Sphagnum* peat. This reflects very changed conditions, since *Sphagnum* could not have grown in water so deep or so calcareous. From investigations of the diatoms and foraminifera of the fen clay, it is concluded that it was deposited in brackish water and that there was also considerable marine influence. This shows that a phase of freshwater peat formation with fen woods was interrupted by a marine transgression, and that, after the upper peat had formed, a phase of increased wetness produced shallow lakes.

In places nearer the sea, there is upper silt several feet thick and several feet above sea-level. Its foraminifera content shows it to represent another marine phase. The upper peat extends below it at about ordnance datum for many miles seawards. The surface of this silt shows abundant traces of Romano-British occupation. In parts, the upper peat has been worn away by drainage and cultivation, exposing the surface of the fen clay at ordnance datum. Thus evidence is found

of two periods of freshwater conditions and two periods of marine transgression as major phases in fenland history.

The lowest and oldest deposits of fenland, however, are out in the North Sea, where big deposits of moorlog have been discovered. These deposits have been found in water as much as 200 ft. deep, and have been shown to contain many species characteristic of the present-day fens or Norfolk Broads. That these deposits may be looked upon as the earliest phase of fenland history has recently been established by the technique of pollen analysis. By identification and statistical analysis of pollen in the deposits, not only can the species of plants be identified but also their periods of dominance. For example, in south Germany there was an early phase of birch-pine dominance, then a phase of hazel, then a replacement of conifers by mixed oak woods followed by beech dominance, culminating in an increase in spruce and fir possibly to be attributed to the felling of beech in historic times.

These phases of forest history have been correlated with archæological remains. For example, the Bronze Age was contemporary with the greatest expansion of beech, and the hazel maximum corresponded with the Tardenoisian. Forest history has been correlated not only with archæological horizons but also with climatic and geological events; thus is forest history dateable in years and may be utilized as an index to all kinds of events of the past. For example, the analysis of a peat bed now buried under salt marsh on the Norfolk coast revealed a marked sequence of phases. To begin with, pine and birch dominated, then hazel, then pine which was later displaced by oak and elm and more especially alder. The last transition was at the Boreal-Atlantic level. Since this pre-Boreal peat is now 10 ft. below ordnance datum, the sea must have been 20 ft. lower in relation to land than it is now; but pollen analysis of the peat from the floor of the North Sea shows that it was in fact much lower than this. The analyses made show only pine-birch with negligible amounts of other trees or hazel, and they almost certainly relate to the pre-Boreal. They are from depths so great as 30 fathoms, so that it is very probable that at this time (about 8000 years B.C.) the North Sea was at least 200 ft. lower in relation to the land than now, and the fens extended right over most of the present floor of the North Sea. As the sea formed during the following centuries, more recent peats were restricted to the shallower coastal areas. The considerable age of the deeper peats has been confirmed by the discovery of a bone fish spear of Mesolithic type in a lump of peat dredged by fishing boats from the Leman and Ower banks off the Norfolk coast.


SCHEME TO SHEW ARRANGEMENT OF POST-GLACIAL DEPOSITS OF THE FENLAND
a Main Fen Estuary of Wisbech
Seaward site with 4 peat beds
Present Coast
of Popham's Eau & St. Germans
UPPER SILT
UPPER PEAT
Landward Limit of Upper Silt
'Old way' between silt levées of Welney
Upper peat removed & fen-clay exposed
Fen margin with buried forests
Upper peat
An 'Old Run' of Nancy site Southery
Fen-clay
Lower peat
a 'Rodden' (silt) of Plantation Farm
Channel 3 (pre Roman)
Shell-marl over raised bog of Trundle Mere
Channel 2 (Late Neolithic)
Sub boreal wood layer
Channel 1
(pre boreal or earlier)
Peat filled river channel of Wilton Bridge
Shell-marl of Ugg Mere
Marginal buried forests of Woodwalton & Wood Fen
River channel through the Fens

FROM "A SCIENTIFIC SURVEY OF THE CAMBRIDGE DISTRICT", PREPARED FOR THE CAMBRIDGE MEETING OF THE BRITISH ASSOCIATION; AND TO BE PUBLISHED UNDER THE TITLE "THE CAMBRIDGE REGION" (CAMBRIDGE UNIVERSITY PRESS, PRICE 6s.).

The excavations and inquiries of the Fenland Research Committee have been limited to the more landward sites. Of particular interest was the excavation of an ancient river channel at Shippea Hill, between Ely and Mildenhall. Here, no fewer than three archæological horizons were discovered stratified into the fen deposits.

Broadly speaking, the fenland history has shown alternating phases of marine invasion and of freshwater conditions. The first freshwater phase in the present fens extended through the Mesolithic and Neolithic periods, and for much of the time the fens were covered with alder-birch fen woods. It was probably about the end of the Neolithic period that marine invasion caused formation of the fen clay. In the Bronze Age which followed, fen woods grew extensively, but these must have been dry enough for prehistoric man, since Bronze Age remains are found abundantly in the fen peats. It is probable that the fens became too wet for occupation in the Iron Age.

In the Roman period, marine invasion once

again dominated fenland history. All the silt of the Wisbech-Spalding area was laid down and its surface intensively cultivated. Along the tidal rivers, silt banks were built up and stood above the surrounding peat land as habitable areas.

After the Romans left Britain, the fens were not exploited until the drainage which began seriously in the seventeenth century. As it became effective, the shallower lakes, such as Whittlesea Mere, Soham Mere and Benwick Mere disappeared. The ground-level sank by shrinkage and wastage of the peat, often as much as one inch a year, and the silt banks of the Romano-British water courses began to appear as raised banks, or 'roddons', crossing the peatland.

There is no reason for supposing that the land and sea movement, which has played such a large part in former fenland history, has now ceased entirely. There is some evidence that recent drainage troubles in the fens are due in part to sinking of the coast. It seems possible that the subsidization of work like that of the Fenland Research Committee would be of value not only to science in general, but also to such scientific applications as the drainage of the fenlands.

Obituary Notices

Dr. Charles Carpenter

BY the death of Dr. Charles Carpenter on September 7 at the age of eighty years, industry loses one of its greatest administrators and applied science one of its staunchest advocates. Trained from his youth as a gas engineer and with an intimate knowledge of gas engineering practice, his delight in precision caused him to realize the value of allying the scientific mode of thought to engineering practice. It was this combination of science and practice which gave the keynote to his technical work. The development of the Metropolitan Argand No. 2 burner was an example of his personal interest in accuracy of detail and the desire to express a quantity so difficult of measurement as illuminating power with the greatest precision possible. It was recognition of the need for closer co-operation between the scientific and the practical man that led him to take so keen an interest in the work of the Society of Chemical Industry, of which he was president in 1915–17, and the dominating theme of both his presidential addresses was the necessity for bringing the often impractical chemist into closer touch with the engineer, whose work was incomplete without the co-operation of a man viewing things from a more academic viewpoint.

Dr. Carpenter's belief that a vigorous chemical industry was necessary to the welfare of Great Britain was behind the strong support he gave to the formation of the Association of British Chemical Manufacturers. During the Great War, his work as adviser to the Ministry of Munitions was made possible by the deep interest he had taken in the practical application of science, and when in 1917 the Advisory Council for Scientific and Industrial Research decided to establish a Fuel Research Board, Dr. Carpenter was able to give material assistance in arranging for a site and facilities to be placed at the Board's disposal. As a member of the Coal Conservation Committee appointed by the Ministry of Reconstruction in 1918, he showed his belief in the importance of applying scientific methods to the problems of fuel treatment and utilization. The value of his work in designing and putting into production gas burners of standardized characteristics and of ensuring a gas supply unchanging in chemical composition and properties has, in later years, received the recognition that it deserves; but the introduction of what seemed to many unnecessary refinements in the control of gas quality and in the removal of naphthalene and sulphur made him appear often to occupy a position of isolation among his contemporaries.

As a pupil and the successor of Sir George Livesey, it was to be expected that the ideals of co-partnership should form the keynote of his relationship with the employees whom he controlled, and if Livesey planted a sapling, it is Carpenter who has cultivated it until it has grown to the dimensions of a healthy tree. His career is throughout a record of painstaking devotion to duty inspired by ideals of honesty and fairness. Entering the South Metropolitan Gas Co. as an engineering pupil at its Vauxhall works, his unusual ability caused him to be appointed to the position of works engineer at the age of twenty-six years, and on the death of Sir Frank Livesey in 1899 he was appointed chief engineer of the Company. When in 1908 Sir George Livesey died, he was chosen by the Board of Directors to succeed him as their chairman, a position which he held, with the altered title of president, until ill-health compelled his retirement in 1937.

E. V. E.

WE regret to announce the following deaths:

Cavaliere Filippo de Filippi, Hon. K.C.I.E., a well-known Italian explorer, who led the Italian expedition of 1913–14 to the Himalaya, Karakoram and Eastern Turkestan, on September 23, aged sixty-nine years.

Prof. Derrick Norman Lehmer, emeritus professor of mathematics in the University of California, on September 8, aged seventy-one years.

Dr. A. S. Mackenzie, president of Dalhousie University, Halifax, Nova Scotia, during 1911–31, formerly professor of physics in Bryn Mawr College, Dalhousie University and the Stevens Institute of Technology, aged seventy-three years.

News and Views

Hugh Miller Commemoration at Cromarty

The cottage at Cromarty in which Hugh Miller was born on October 10, 1802, was handed over to the National Trust for Scotland on September 26. The occasion was of interest not only to geologists but also to many who have been attracted to his writings by their highly individual style and charm, and to those who are interested in the religious history of Scotland in the nineteenth century. Few geologists have appealed to such a large reading public as did Hugh Miller; his assured place in the history of the science depends perhaps no less upon the stimulus and influence of his work than on its actual scientific content. His apprenticeship to a stonemason turned his attention to the geology, and particularly to the sedimentary rocks, of the north-east of Scotland. He made the Old Red Sandstone a familiar term all over the world, and his book with that title "amazed and delighted" such an eminent geologist as Buckland. Many of his other books were original attempts to make palæontology a contribution to Christian apologetics; Miller, as editor of the *Witness*, played a large part in the "non-intrusionist" movement in the Church of Scotland. Other collectors such as Robert Dick of Thurso (an acute observer who might, one feels, have rivalled Miller as a writer) looked upon Miller as their mouthpiece, and their new specimens and information were often made known through him. Miller's lack of orthodox anatomical knowledge was balanced by a "natural insight", and, even though much of his writing is now disregarded, his contributions to geology and to English letters form a durable record.

Anniversary of the Discovery of Radium

The fortieth anniversary of the discovery of radium is the occasion for the issue in France of a special postage stamp in honour of the discoverers, Pierre and Marie Curie. Their lives and characters have been well revealed by their daughter Eve Curie, who

wrote that her mother did not know how to be famous, while Einstein declared that Mme. Curie alone of famous people was unspoiled by prosperity. Her other daughter, Irene, has carried forward the illustrious scientific work of her parents by her discovery, with her husband, Prof. Joliot, of 'artificial' radioactivity. The stamp, printed in blue, is excellent in design and carries faithful portraits, as may be seen by the accompanying reproduction. It carries a surtax of half a franc for the benefit of the "Union Internationale contre le Cancer". On its merits, this stamp should have a wide appeal, enhanced by the desire to aid in the fight against a baffling disease.

The International Union against Cancer, which comprises ninety-two organizations representing fifty-two nations, has succeeded in arranging for an International Week against Cancer on November 23–30, which it is hoped will take place simultaneously in fifty countries. In connexion with the celebrations, an international commemoration of the discovery of radium, electrons, X-rays and Hertzian waves will take place on November 23 at the Sorbonne, and a number of papers have been promised by distinguished scientific workers, including O. Hahn (Berlin-Dahlem), G. Hevesy (Copenhagen), G. P. Thomson (London), M. von Laue (Berlin), A. Sommerfeld (Munich), J. Errera (Brussels), F. Carter-Wood (New York), J. D. Bernal (London), H. Stubbe (Berlin-Dahlem), A. Bouwers (Eindhoven) and L. Marton (Brussels), in addition to French men of science. Further particulars of the meeting can be obtained from the secretary-general of the Semaine Internationale contre le Cancer, 18 rue Soufflot, Paris (V).

Czechoslovakia's Future

Dr. Gerald Druce, who was the first English graduate of the Charles University of Prague after the Great War, writes as follows: Relief that war has been averted is shared by the peoples of all nations. Thanks to the uses that would be made of accumulated scientific knowledge and skill, a world war to-day would be of such intensity and so ruthless that there would be no victory for the victors, whilst the vanquished might well suffer extinction. Mankind has been mercifully spared this fate, but at the expense of a cultured and highly respected, if small, nation. The Czechoslovaks have accepted proposals made "without and against them", the economic and cultural consequences of which cannot be foreseen. The territory ceded at once includes the whole of the Ore Mountains, so that the mineral wealth of north-west Bohemia will no longer be available for the metallurgical and engineering establishments of Pilsen and Prague. The pitchblende mines of Jáchymov (St. Joachimsthal), together with the radium institute so largely developed by the Czechoslovak Ministry of Health, have also been lost. In this area, too, the Aussig chemical concern has most of its plant and research stations. The economic losses, of which the above are but examples, will necessitate curtailment of expenditure upon scientific and educational work in the residual State. Hitherto, the Czechoslovak Ministry of Education has generously supported the universities and other scientific and educational establishments, but it cannot continue on the same scale that has hitherto been possible. From the maps published in the Press, it appears that Brno (Brünn), the capital of

Moravia, is included in one of the areas where a plebiscite is to be held. Should this city, with its university erected after the War and named after President Masaryk, and its technical colleges and museum, be transferred to Germany, it may well be asked how the republic is to continue. The future of the German University of Prague (the only one provided for a minority in Europe) is also a matter for concern. Will the Czechs feel justified in expending money upon it whilst their own establishments languish? Whatever happens, it is highly probable that serious academic research, such as the world has become accustomed to associate with Prague and its ancient university, will be impeded for a long time to come.

The Physical Society

WHEN the Physical Society of London was founded in March 1874, a paper "On the New Contact-Theory of the Galvanic Cell" was read by J. A. Fleming (now Sir Ambrose Fleming). Since then, sixty-four years have elapsed, yet this veteran physicist and engineer is still taking part in scientific work. It is therefore with particular interest that we see the announcement in the Society's programme that he is to give an address on January 13 next, on "Physics and Physicists of the Eighteen-Seventies". Other noteworthy meetings included in the programme are: the twenty-third Guthrie Lecture by Prof. A. V. Hill, on the transformation of energy and the mechanical work of muscles (Nov. 11); a discussion on electro-acoustics, to be opened by Dr. C. V. Drysdale (Dec. 9); discourse by Dr. J. D. Cockcroft on the cyclotron and its applications (Jan. 3); discourse by C. S. Wright on geophysical research in Polar regions (Jan. 4); joint meeting with the Royal Astronomical Society for a discussion on the expanding universe, to be opened by Prof. G. F. J. Temple and Dr. G. C. McVittie (Jan. 27); the Thomas Young oration by Brigadier M. N. MacLeod on some recent developments in British surveying instruments (March 24); and joint meeting with the Chemical and Royal Meteorological Societies, for a discussion on chemical and physical investigations of the upper atmosphere, to be opened by Prof. F. A. Paneth (May 4). The president of the Society this year is Prof. Allan Ferguson; and it is evident from the programme that he desires the meetings to be of wide interest and not confined to the communication of technical papers which are better presented by title for publication in the *Proceedings* than read.

Roman Villa in Yorkshire

REMAINS of a Roman villa have been brought to light, contrary to anticipation, at Well, a village of the Dales in the North Riding of Yorkshire. Although the site was known to be Roman, it was thought to be too far north to be likely to provide evidence of occupation of any considerable interest. As the result of a week of excavation, however, the walls of bath buildings, which had been connected with a villa, and the floor of the cold water plunge bath have been brought to light. The floor has a tessellated pavement with plaster moulding, and the walls are plaster-lined. There is evidence that the walls had been twice rebuilt, once after a fire. A piece of 'Huntcliffe' pottery indicates that occupation had been so recent as the last quarter of the fourth century. Other pieces of pottery and a coin have been found. Excavation is now being directed to a search for the hot bath room and the walls of the main buildings of the villa, which it is hoped to discover nearby. In view of the geographical situation of the villa, this find is likely to prove of no little interest as an indication of the relation of civil settlement and military occupation, more especially at so late a date. The excavation is being carried out under the supervision of Mr. Gilliard Beer and Mr. Kitson Clark of Leeds, both members of the Roman Antiquities Committee of the Yorkshire Archæological Society. It is stated in a report on the excavation, which appeared in *The Times* of September 28, that owing to lack of funds it will not be possible to continue the work of excavation beyond the middle of October. It would, indeed, be unfortunate if what may prove an important investigation in its bearing on a critical period should have to be abandoned before completion.

Houses of Viking Age in Eire

PROVISION for archæological exploration and research continues to be made as part of the measures for the relief of unemployment put into operation by the Government of Eire. In the systematic plan of archæological investigation which it has been possible to frame as a result of the resources, financial and other, made available in this manner, the exploration of the forts, which form such an important class of Irish antiquities, naturally take a prominent place. An account of the results obtained in an examination of one such site on Lough Gur, Co. Limerick, of which the excavation was carried out under the supervision of Prof. S. P. O'Riordain in the present season, is given by a correspondent of *The Times* in the issue of October 3. These results are of special interest as the excavation of the fort brought to light evidence of the character of the house in Ireland in, it would appear from the associated finds, the period of the Vikings about A.D. 800–1000. Both inside the fort and outside its walls were the remains of several houses built of stone. One of them, outside the southern rampart, was a long rectangular structure, built in such a way that the face of the wall of the fort formed a wall of the house. The houses outside the wall to the north were provided with yards. Although of different types, all were of stone. They were paved, and in some of the rooms were hearths. In one building the roof had been supported by timber posts, for which the holes were found. A large number of objects for everyday use, of iron, bronze, stone, and bone were found, which serve to date the site as of the Viking period. A coin has been identified as an imitation, or copy, of a coin of Constantine, such as continued to be made in Britain long after the Roman period. A hoard of Viking silver would appear to have belonged to a metal worker, and included silver bracelets which had been broken up preparatory to being melted down.

Atmospheric Pollution

READERS of the daily Press might excusably conclude that physical fitness is solely a matter of physical exercise. It appears to be taken for granted that everyone has free access to the essentials of wholesome food, water and air. Yet the free access to good air does not in fact exist in our large towns, and without it full advantage of facilities for physical culture cannot be taken. For this reason it is of timely interest to inquire how efforts progress towards improving urban atmosphere. The twenty-third report of the Investigation of Atmospheric Pollution (H.M. Stationery Office. 7*s.* 6*d.*) discloses statistical evidence of slight improvement, but cautiously expressed. One large city at any rate—Leicester—has started an intensive survey of its own area and surroundings. At twelve stations, systematic records will be taken of pollution by suspended matter, sulphur impurities and of ultra-violet light. Although the collection of data may of itself effect nothing, it may stimulate and provide a guide to ameliorative action. Previous reports have directed attention to the considerable atmospheric pollution of central London. In this one, a recommendation is reported by a committee formed on the initiative of the London County Council, to reduce the emission of grit which modern practice of intensive firing seems to promote. This recommendation refers to "the important contribution which could be made to the diminution of the grit and dust nuisance if they themselves [that is, public authorities] made a practice in their municipal undertakings of using 'washed' coal wherever possible and if they would press industrial undertakings in their respective areas to do so". This is a timely recommendation, for public authorities control a very large amount of fuel-using plant, and some do not by any means set a good example.

Shale Oil Industry

THE present position of the shale oil industry was clarified at an International Congress held in Glasgow in June last under the auspices of the Institution of Petroleum Technologists. Dr. E. F. Armstrong reports (*J. Roy. Soc. Arts*, August 12, 1938) that at the beginning of the Great War the yearly production of shale reached a maximum of 3¼ million tons; to-day only about half this quantity is produced. This is partly due to the fact that the oil yield is directly proportional to the fossil algæ content of the shale, from which it is believed to originate; this fossil algæ content is less in the lower and geologically older shale strata. Thus the average yield to-day is 16–20 gallons per ton, whereas, in 1875, it was 30 gallons per ton. Rapid development of natural petroleum has also influenced the shale industry. Shale has to be mined and distilled before oil can be obtained and, therefore, without some form of protection, shale oil cannot compete with petroleum oil. Nevertheless, in spite of obvious handicaps, the shale oil industry is being kept alive in Great Britain and other countries, and it may be that at some future date when natural resources of petroleum have been depleted it will become a major industry, particularly as it is capable of producing both Diesel oil and motor spirit.

International Studies of Health

IN May 1937 the Health Committee of the League of Nations decided to organize a sixth meeting of the directors of institutes and schools of hygiene in Europe. These periodic meetings consider the studies carried out by the institutes as co-ordinated by the Health Organisation and the future programme of activity. At their meeting last November, the directors agreed that the institutes represented should undertake studies on health indexes, enteric fever, brucellosis, the incidence of tuberculosis and methods of tuberculosis control and nutrition in rural areas. The studies are to be co-ordinated by the Health Committee, and technical meetings of representatives of the institutes concerned have been organized by the Committee in preparation for the European Conference on Rural Life, the Preparatory Commission of which has commenced its labours. M. A. Wauters, the Belgian Minister of Health, who was elected president of the Commission, stressed the value of the scientific work it was undertaking independently of the international situation. Particular questions which are being examined by the Commission with a view to inclusion in the agenda of the Conference are: the problem of raising the standard of living; the development of agricultural credits; the results of the inquiry on nutrition; the study of housing problems; medical equipment in rural districts; physical education; and the combating of certain diseases which have particularly serious consequences in rural districts. The Preparatory Commission includes a certain number of persons who have undertaken responsible work for their Governments in rural life.

Cultural Pedigrees: Some Recent Examples

SOME interesting examples of culture lag and pedigrees of cultural elements are afforded in several of the articles which appear in *Antiquity* of September. Of these, the most considerable is Dr. E. Cecil Curwen's note of "The Hebrides", in which it is argued that "If we had visited Lewis even fifty years ago, we should have been able to study the life and manners of a Celtic-speaking race emerging from roughly the same state of culture as the Celtic people of the pre-Roman Iron Age in Wessex". Dr. Curwen naturally devotes careful attention to the details of the still numerous, but disappearing, 'black house' and the now disused beehive sheilings, a survival of the megalith builders in use fifty years ago. Of the black houses he remarks that it is only since the recent introduction of tuberculosis that they have become unhygienic, and that in the seventeenth and eighteenth centuries centenarians were far more common in the island than they are now, even attaining the ages of 140 and more. A contribution to the pedigree of the St. George cult is made in an article, in translation, by Dr. Gawril Kazarov, in which he links St. George with the numerous pre-Christian rider-hero cult shrines and figures of Thrace. The hero cult survives in Bulgaria in folk-

lore, the siting of shrines, and the overwhelming importance of St. George's day in the popular festal calendar. An inquiry on somewhat similar lines by Mr. Stuart Piggott traces Hercules, "the simple good-hearted strong man", back to Akkad, *c.* 2550 B.C., and in post-classical Europe down to Harlequin, a polished and sophisticated version of the god of the underworld. The discerning will note that *Antiquity* shows no falling off in demonstrating practically that solid learning need not be dull.

Protecting Marine Cables

ONE of the most prolific sources of damage to ocean cables is the heavy drags, called otterboards, which are attached to the nets of steam trawlers and dragged along the ocean bottom. In the *Nickel Bulletin* of September, it is estimated that the damage caused to cables by the steel runners of otterboards averages about £100,000 a year. To get rid of this source of loss, the Western Union Telegraph Co. has, for some time, been experimenting with a submarine plough which will automatically make a furrow in the bottom of the ocean, feed the cable into it and cover it up. The cable will then be buried at a depth sufficient to ensure that the otterboards cannot come into contact with it. Encouraging results have been obtained from experiments made so far, but many difficulties have had to be faced. A new series of experiments has now been started off the Irish coast. The plough is towed by the cable-ship *Lord Kelvin*. In handling the equipment a very flexible towing line had to be provided able to withstand a load of 29 tons. The ordinary equipment necessitates that the line must be neither too light nor too rigid. It must be capable of being paid out gradually from the ship while ploughing under full load. After careful investigation and a series of tests it was found that 'di-lok', a special chain made of 3½ per cent nickel-steel, was quite suitable. In order to get continuously smooth operation a very minute tolerance on the size and shape of each individual link was imposed. The requirements were about five times as severe as those imposed by the U.S. Navy in their specifications. There are eleven Western Union trans-Atlantic cables and eight of these pass through fishing areas off the Irish coast where most of the ploughing work will be carried out.

Carnegie Institution of Washington

A VALUABLE addition to the administration building of the Carnegie Institution of Washington has for some time been under construction and will probably be completed in time for the usual Institution lectures in late October or early November. The new structure has been designed primarily to facilitate development of the public relations programme of the Institution by improving conditions for handling its publications, and for more direct contacts with the public through lectures, conferences and exhibitions. The principal room in the addition is an auditorium, designed to seat about five hundred, which, under the name of Elihu Root Hall, is being dedicated to the memory of Mr. Root. Up to the present time the facilities for lecture programmes have been limited to a room seating comfortably about half that number, and it has been necessary in most cases to limit invitations to those who have something more than a general interest in the subjects presented. With the accommodation now in preparation it will be possible to include a larger invitation list with freedom to invite men of science and laymen representing all fields of interest. Committee and conference rooms have been designed for the special purpose of arranging for discussions with a limited group of special students of subjects under consideration, and thus promote inquiries and research into the particular field of natural knowledge in which they are engaged.

THE exhibitions of the Institution held in recent years at the time of the annual meeting have served an important purpose in bringing together representatives of all the departments and in presentation of some of the most important results of their researches. These contacts have had much value in development of co-operative relations between research groups of the Institution. The exhibitions have also served an important purpose in that they make possible the contact of the Trustees at the time of the annual meeting with all of the departments, especially through giving opportunity to see results of some of the most interesting investigations. In past years, the annual exhibition has been possible only by use of the regular offices of administration, to the exclusion of much of the ordinary business at the time of the annual meeting. The new building will include rooms which are much more commodious and better organized for exhibition purposes than those thus far available, and use of these quarters will permit the regular business of the administrative offices to be carried on during the period of the annual meeting. The new exhibition rooms will also permit certain exhibits at the administration headquarters to be retained throughout the year if this seems desirable.

The Institution of Professional Civil Servants

THE nineteenth annual report, for 1937, of the Council of the Institution of Professional Civil Servants refers to the spectacular increase in membership from 9,076 in 1935 to 13,896 at the end of 1937. Activities of the Institution during the year were directed largely to obtaining improvements in the salary scales of its members. Despite the multiplicity of grades and salaries, considerable success has been achieved both by negotiation and by arbitration. The common scale possessed by certain architectural surveying and civil engineering grades in the Civil Service enabled the Institution to secure improved salary scales by central discussion, and acceptance of the Institution's proposals for the simplification of grades and salaries of the professional, scientific and technical classes in the Civil Service which were submitted to the Tomlin Commission would greatly reduce the task of negotiation and lighten the work of the departmental establishment officers. The Institution has also participated in the work of the National Whitley Council, and the report includes a full account of

discussions on the increased cost of living. It has also taken part in the consideration of problems involved in the reorganization of the Post Office through its Post Office Committee, and the Post Office Engineering and Stores Departmental Whitley Council. Preliminary consideration is also being given to the adequacy of the Carpenter scheme in view of the magnitude and rapidity of developments in scientific establishments since the publication of the Carpenter Report in 1930.

The Strangeways Laboratory

In the report for 1937 of the Strangeways Research Laboratory, Cambridge, the trustees are able to announce that an anonymous donor has guaranteed an additional £500 a year to the income of the trust for five years. This subscription has enabled the trustees to accept the offer of the Rockefeller Foundation of the capital cost of an extension. The new buildings will provide additional accommodation for laboratory work, and will enable satisfactory arrangements to be made for the library and the workshops. During the year, the record number of twenty-five persons has worked in the Laboratory, and it is a testimony to its reputation that of these, eleven should be visitors from other laboratories in Great Britain and abroad. The British Empire Cancer Campaign has equipped the Laboratory with a 200 kv. X-ray apparatus, and has purchased a 300 mgm. radium plaque, which had been on loan. This has enabled the work on the irradiation of tissues to be continued, and it is now being extended from the preliminary observations *in vitro*, to the more difficult problems encountered *in vivo*. Of the sixteen papers published from the Laboratory during the year, nine are concerned with embryological problems, three with the effects of radiation on living material, and the remainder with the metabolism of tumour tissue and the physiology of the embryonic heart.

Forest Products Research Board

The report of the Forest Products Research Board for the year 1937 forms an introduction to the report of the Director of Forest Products Research at Princes Risborough for the same year (London: H.M. Stationery Office, 1938. 2*s*. net). The Research Board briefly reviews the work of the year and the measures laid down to be observed in future in the preparation of reports on mechanical tests of timbers; the grading of structural timbers; and plywood and other materials built up from wood. An extensive investigation into the latter and allied materials is proposed; a study being made of 'composite wood', that is, of industrial materials made of laminated or disintegrated wood. An investigation is also to be carried out into the possibility of producing from home-grown timbers charcoal for use in the chemical and other industries, a prominent manufacturing firm having made an offer of a grant towards the cost of this work. The Director in his report acknowledges the important direct help which the physicist and chemist can give to the various branches of the timber-using industry.

Central Medical School, Fiji

The Central Medical School at Suva, Fiji, founded in 1929, of which an account was given by Sir James Barrett in NATURE of September 11, 1937, p. 472, has recently issued its annual report for 1937. During the year, there were 43 students in the school, 13 of whom were in their first year, 13 in their second, 14 in their third and 3 in their fourth. In addition to students from Fiji, the school was attended by students from Samoa, Tonga, Cook Islands, Gilbert and Ellice Islands, Solomon Islands, New Hebrides and Nauru. The approximate annual cost for each student was £74, which included board and lodging, tuition fees, maintenance expenses, clothing, servants' wages, and pocket money, so that the four years' course of study amounted to about £300 per student. The average number of Fiji students who qualify each year is four, and there is an average annual loss of two. In Fiji, there is one native medical practitioner for every 1,600 of the population, and if the seven Indian medical practitioners and the 86,000 Indian population are included, there is one qualified man for 2,700 of population. Lists of the lecturers, prize winners and text-books used at the school are included in the report.

Social Services and Venereal Disease

The Secretariat of the League of Nations has recently issued an account of the systems prevailing in different countries for the provision of social, as well as medical, services in the treatment of venereal disease ("Social Services and Venereal Disease". Geneva: League of Nations; London: Allen and Unwin. 1938. 1*s*. 3*d*.). The necessity for cheap medical treatment for venereal disease is now widely recognized, in some countries is compulsory, in others, including the United Kingdom, it is voluntary but is encouraged by the State. There is not the same wide recognition of the need for social help, and the number of countries where social service is combined with medical treatment at clinics and hospitals is still comparatively small. Where they exist, these social services take different forms. An account is given in the booklet of the systems in use in the United Kingdom and France, and suggestions are given for future planning which should prove of value to social workers in all countries.

Yields of Fruit and Vegetables

Some figures issued by the Ministry of Agriculture on September 2 outline the condition of various horticultural crops in many centres of Great Britain. Whilst the main interest of this survey is doubtless economic, it should also be interpreted as indicating a potent need for research into the cropping of fruit trees. Apple yields of Bramley's Seedling, Cox's Orange Pippin and cider varieties have only amounted to between 10 and 40 per cent of their capabilities. They were somewhat higher in 1937, but even then the crop average was decidedly below 50 per cent. Runner beans, Brussels sprouts, cabbage, carrots, parsnips, peas and onions yield, in general, crops of 60–80 per cent, and were slightly better last year. The poor cropping of the apple for 1937 and 1938

revealed by these returns is not an isolated instance, for the crop of 1935 was also very low. Damage by spring frosts and inadequate pollination are doubtless causes of low yield, but it should be possible for modern science to raise the apple's cropping potentialities above 50 per cent in most years.

A Practical Form of Electrophoresis Apparatus

IT has long been known that proteins differ widely in their rates of migration in an electric field, and many attempts have been made to use this phenomenon for purposes of separation and identification by so-called 'electrophoresis'. The principle is particularly attractive since even highly unstable substances are unlikely to be damaged by the treatment. One is therefore at first surprised at the scanty results yielded so far by so promising a method. The reason is that until recently no apparatus had been designed which could claim to have overcome the many technical difficulties. In the last few years, however, there has been steady improvement in this respect, associated largely with the names of Dr. Theorell of Stockholm and Prof. Tiselius of Uppsala. The latest form of Tiselius apparatus, which has now been placed on the market by Messrs. F. Hellige and Co., of Freiburg, enables the separation to be followed both optically and analytically, while the resolving power for small differences of mobility has been greatly increased. A direct result of these improvements has been the detection and isolation of the three components of serum globulin (Tiselius, *Biochem. J.*, **31**, 1464; 1937) which has answered an old and much disputed question. The apparatus is already in use in several other laboratories, and promises a host of further interesting results, for example, in the study of pathological sera, immune bodies and enzymes.

Quekett Microscopical Club

THE Quekett Microscopical Club is holding its annual conversazione on October 11 at 7.30 p.m. at Burlington House, Piccadilly, London, in the rooms of the Royal Society. Dr. Arnold Renshaw of Manchester will lecture upon the microscope in the detection of crime. It is not generally known that pieces of tissue (flesh, etc.) can be cut in slices so thin as a twenty-five-thousandth of an inch. A film made by Mr. Pittock of the Department of Anatomy and Embryology, University College, Gower Street, will be projected following Dr. Arnold Renshaw's lecture, showing all the stages in preparation and the actual cutting of these sections. Eighty microscopes will be set up each showing different specimens. In addition there will be several demonstrations. Mr. Edwards of the Haslemere Museum will give continuous projection during the evening of living pond-life. A group of members will show the method of collecting, cleaning, etc., of Diatomaceæ. Methods of recording by means of drawing specimens and structures seen under the microscope will also be demonstrated. Dr. Gunther, of the Old Ashmolean, Oxford, will stage a demonstration of contributions by the late Mr. E. M. Nelson to microscopy. In addition to this, Dr. Gunther will give a demonstration of the original works of Hooke, showing proofs of the plates and the first editions of his book. It is hoped that the Royal Society, which owns a Hooke microscope, will exhibit it. Demonstrations are also expected from the British Museum (Natural History), King's College, Queen Mary College, etc. Cards of admission can be obtained from the Assistant Secretary, Miss Arnold, 58 Warwick Road, Ealing, W.5.

Announcements

DR. HAROLD J. PLENDERLEITH has been appointed deputy keeper in charge of the research laboratory of the British Museum, in succession to Dr. Alexander Scott, who has been honorary director of the laboratory since its institution in 1919.

THE following representatives to the Scientific Advisory Committee of the Trades Union have recently been appointed by the General Council: Mr. J. Hallsworth (chairman of the General Council), Mr. E. Bevin, Mr. J. Brown, Mr. C. Dukes, Mr. H. H. Elvin, Mr. G. Gibson, Mr. W. Holmes, Mr. W. Lawther, Mr. G. W. Thomson, and Sir Walter Citrine. On advice furnished by the general officers of the British Association the scientific representatives on the committee will be: nutrition and agriculture, Sir Daniel Hall and Sir John Orr; physics, Prof. Allan Ferguson and Prof. P. M. S. Blackett; chemistry, Prof. F. G. Donnan and Prof. A. C. G. Egerton; physiology and psychology, Prof. Winifred Cullis; population, Prof. L. Hogben; metallurgy, Prof. J. D. Bernal; geology and geography, Prof. P. G. H. Boswell; engineering, Mr. J. S. Wilson.

THE Hydrobiology and Fisheries Laboratory, Alexandria, a description of which appeared in NATURE of June 18, p. 1107, has, by Royal decree, been named the Fouad I Institute of Hydrobiology and Fisheries.

THE fiftieth anniversary of the foundation of the Pasteur Institute of Paris will be celebrated on October 26 in the presence of the President of the French Republic and the Minister of Health.

THE American Academy of Arts and Sciences gives notice of the Francis Amory Septennial Prize for outstanding contributions to knowledge of diseases of the human sexual organs. The first award, which will be made in 1940, will exceed 10,000 dollars. There will be no formal nomination and no formal essays or treatises will be required. Further information can be obtained from the Amory Fund Committee, American Academy of Arts and Sciences, 28 Newbury Street, Boston, Mass., U.S.A.

A PRINTED supplement (Bulletin 1937, No. 3, Supplement No. 1, Washington, G.P.O., 1938. 10 cents) to the index to Public Affairs Pamphlets has now been issued by the Office of Education, United States Department of the Interior. It contains an annotated list of a further 552 pamphlets together with a report on the pamphlet display demonstration centres, and author, subject and title indexes.

Letters to the Editor

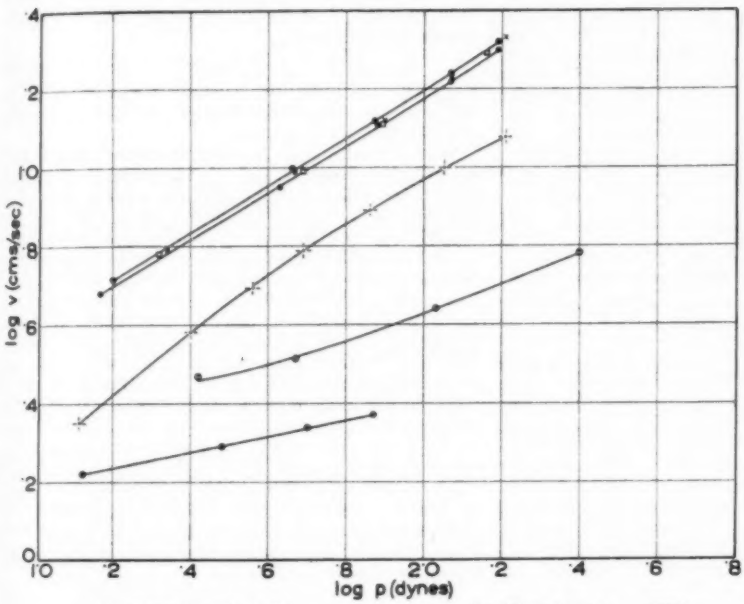
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 675.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Flow Phenomena in Liquid Helium II

RECENT measurements on the flow of liquid helium II through capillaries have yielded very varied results. We reported earlier[1] that the flow through long capillaries bore no relation to a normal laminar or turbulent condition of the liquid, and that the velocity depended only slightly on the pressure head.



Capillary length	T°K.	Capillary length	T°K.
□ 6 mm.	2·164°	× 6 mm.	1·161°
● 11·5 mm.	2·164°	• 11·5 mm	1·161°
◉ 40 cm.	2·164°	° 40 cm.	1·161°
⊹ 11·5 m.	2·2° (helium I)		

Since that time we have made many further observations on flow through capillaries varying in radius from 0·05 cm. down to 6×10^{-5} cm., as well as through tubes filled with tightly packed rouge. The smallest capillaries were produced by drawing down german silver tubes closely packed with fine stainless steel wires. The full details will be published elsewhere but the main results are as follows.

(i) The rate of flow in all cases in capillaries more than 15 cm. in length depended only slightly on the pressure head. (ii) The smaller the cross-sectional area of the capillary the more independent of head did the velocity become. For the finest capillaries the flow became completely independent of head for all pressures from zero to 200 dynes. (iii) The pressure-independent velocity increased very rapidly between 2·177° K. and 1·15° K.

Although Kapitza[2] was only able to observe turbulent flow, Burton[3] and Giauque, Stout and Barieau[4], in recent papers, have recorded laminar flow in helium II and suggest that the type of pressure-independent flow which we have observed might be due to the transport of liquid in surface films, such as have been observed by Daunt and Mendelssohn[5]. In all our experiments precautions were taken against such a flow. For some of the measurements on the larger capillaries a reservoir was used which was completely closed except for the capillary opening. When open reservoirs were used, they were invariably made with constrictions 1 mm. in diameter at the top, thereby reducing the surface transport. In these cases, duplicate reservoirs with no capillary attached and closed at the bottom were fastened side by side with the flow reservoir. The correction for the flow due to surface films was usually less than one per cent and for the finest capillaries was not greater than seven or eight per cent.

Since the above results might appear to be in conflict with those of Burton[3] and Giauque[4], we have made some measurements under experimental conditions similar to Burton's. A reservoir diameter of 16 mm. and a capillary diameter of 0·03 cm. was used, and observations were made using three different lengths: 6 mm., 11·5 mm. and 40 cm. The results are shown in the accompanying diagram. Logarithmic curves are given for two measuring temperatures in helium II, and in the case of the 11·5 mm. capillary for a temperature in helium I of approximately

2·2° K. In no case in helium II was a purely laminar flow observed, although in the case of the two shorter capillaries the curves might indicate a semi-turbulent condition. If we assume the flow to be laminar and calculate the viscosity from Poiseuille's formula, we obtain a value of $7{\cdot}8 \times 10^{-4}$ c.g.s. units with $R = 280$, which agrees with Burton's value for a capillary of somewhat the same length. On the other hand, shortening the capillary length to 6 mm. appears to have very little effect on the velocity, and lengthening the capillary to 40 cm. has the effect of decreasing the velocity only by a factor of five at 2·160° K. Lengthening the capillary also has the effect of making the velocity much more independent of pressure. It is noted that although the velocity through long capillaries increases with decreasing temperature, the velocity through the shorter capillaries actually decreases by about 5 per cent from 2·160° to 1·165° K. For purposes of comparison, a measurement of the flow in helium I, just above the λ-point, was made. The flow was observed to be laminar for low velocities and turbulent for high velocities. The viscosity was found to be $1{\cdot}4 \times 10^{-4}$ c.g.s. units, which is in fair agreement with previous measurements.

J. F. ALLEN.
A. D. MISENER.

Royal Society Mond Laboratory,
Cambridge.

[1] Allen, J. F., and Misener, A. D., NATURE, 141, 75 (1938).
[2] Kapitza, P., NATURE, 141, 74 (1938).
[3] Burton, E. F., NATURE, 142, 72 (1938).
[4] Gianque, W. F., Stout, J. W., and Barieau, R. E., *Phys. Rev.*, 54, 146 (1938).
[5] Daunt, J. G., and Mendelssohn, K., NATURE, 141, 911 (1938).

Effect of Collisions on the Intensities of Nebular Lines

THERE appears to be a widespread misconception concerning the effect of electron collisions on the intensities of forbidden lines. The prevailing view appears to be that, at high densities, collisions of the second kind operate to de-excite atoms from the metastable levels before the atoms have a chance to radiate, and that only at low densities, as in the gaseous nebulæ, can a sufficiently high population of atoms be obtained to give appreciable intensity to the forbidden lines. The mathematical reasoning advanced to support this argument[1] is as follows. Let $N_1 b_{12}$ be the number of atoms excited per second from the ground to the metastable level by inelastic electron impact, which process is ordinarily assumed to be the predominant source of excitation. Let $N_2 b_{21}$ be the number of super-elastic collisions per second. Let A_{21} be the Einstein probability of spontaneous emission. Then the intensity of the line may be written:

$$I = \frac{N_1 b_{12}}{b_{21} + A_{21}} A_{21} h\nu \qquad (1)$$

The customary argument is that the increase of b_{21} with density causes the value of I to decrease.

The fallacy in the reasoning lies in the fact[2] that the excitation coefficients, b_{12} and b_{21}, both being proportional to the electron density, keep exactly in step. Furthermore, they are closely related, so that one may be expressed in terms of the other. Equation (1) is easily transformed to the following equivalent expression:

$$I = N_1 \frac{\bar{\omega}_2}{\bar{\omega}_1} e^{-h\nu/kT} \left(\frac{1}{1 + A_{21}/b_{21}}\right) A_{21} h\nu, \qquad (2)$$

where the $\bar{\omega}$'s refer to the statistical weights of the respective levels. Since practically all the atoms are in the lower level, we may regard N_1 to be the total number of atoms in the assembly. The first factor represents a Boltzmann distribution, which would be accurately attained if A_{21} were zero. The second factor, enclosed in parentheses, is always less than unity. A_{21} is an atomic constant. I reaches a maximum when $b_{21} \gg A_{21}$, that is, when the electron density is *high*. This conclusion is the reverse of that stated in the first paragraph.

Part of the misunderstanding may arise from the erroneous belief that if the probability of collisional de-excitation is greater than the probability of emission, the atoms do not have time to radiate. This reasoning would imply a difference between an atom that arrived in a metastable state 10^{-8} seconds ago and one that may have existed in that level for some seconds. The argument would imply that the quantum equation,

$$I = N_2 A_{21} h\nu \qquad (3)$$

is wrong. The intensity depends solely on the population and atomic constants, and the highest intensity occurs when N_2 is greatest.

When equation (2) is applied to the normal lines, with high values of A_{21}, we discover that serious departures from thermodynamic equilibrium, with consequent fading of permitted lines, may be expected at densities from 10^6 to 10^8 times greater than for the forbidden lines. Where, in a nebula, the forbidden lines may occur with intensities not far from their thermodynamic values, the permitted lines will have their intensities greatly decreased from the laboratory values. The predominance of the forbidden lines in nebular spectra, therefore, is attributable, not to the effect of collisions in de-exciting an atom before it has a chance to radiate, but to the weakness of the permitted lines. The high absolute intensity of the forbidden lines is explicable only in terms of the large total mass of the nebulæ. The predominance of normal lines in laboratory spectra is due chiefly to the high values of the associated Einstein A's, though collisions of excited atoms with the cool walls of a tube, an essentially irreversible process, may affect the relative intensities.

The foregoing analysis can be extended to atoms with more than one excited level. One may also show that removal of the atoms from the metastable levels by radiation processes does not result in an appreciable lowering of the level population, in contradiction to the results of Eddington[3].

Note added in proof (Sept. 19). Kaplan[4] reports that certain forbidden lines, observed in the nitrogen afterglow, drop in intensity as the pressure goes down. He remarks, "Since these radiations originate in relatively forbidden transitions, it is of considerable astrophysical interest to report an increase in intensity with pressure rather than the expected decrease." The observational proof of the points raised in the foregoing letter seems to be already available.

DONALD H. MENZEL.

Harvard Observatory,
Cambridge, Mass.
Aug. 19.

[1] cf., Bowen, I. S., *Rev. Mod. Phys.*, 8, 55 (1936).
[2] cf., Fowler, R. H., "Statistical Mechanics" (2nd ed.), 677–684.
[3] Eddington, A. S., *Mon. Not. Roy. Astro. Soc.*, 88, 134 (1927).
[4] Kaplan, J., *Publ. Astro. Soc. Pacific*, 50, 228 (1938).

(*Continued on p.* 669.)

NATURE

SUPPLEMENT

Vol. 142 SATURDAY, OCTOBER 8, 1938 No. 3597

REVIEWS

Audubon

Audubon, the Naturalist: a History of his Life and Time. By Prof. Francis Hobart Herrick. Second edition, two volumes in one. Pp. xcii + 451 + 500 + 56 plates. (New York and London: D. Appleton-Century Co., Inc., 1938.) 25*s.* net.

THIS work may be described as the standard biography of Audubon, from which the lighter and more romantic versions which have appeared from time to time have largely been drawn. It is strange that a life so full of genuine romance and adventure, a personality so individual, magnificent alike in stubborn courage and childlike carelessness and candour, should fail to satisfy the appetites of so many biographers without the added condiment of a fictitious royal birth. Prof. Herrick's careful account of Audubon's early life, in the first edition, would seem to have settled the matter; but subsequent publications have again promulgated the wild hypothesis that the poor fragile Dauphin and the vigorous naturalist were one and the same: certain members of the Audubon family were drawn to the idea, disliking the illegitimate and Creole birth of their ancestor. Prof. Herrick's new foreword and postscript must convince all but the wilfully credulous.

The first part of the book deals with the life-history of Audubon from his birth and adoption, his short period in a naval college, his abortive studies in the studio of the celebrated David, his emigration to America, his many struggles in business, and the two fixed points in the kaleidoscope of his life—his great wife Lucy and his dominating passion for birds and beasts and for their portrayal. Such business ventures as he made, even to portrait painting and the teaching of dancing, were all undertaken so as to get means for pursuing this, his chosen work; his Lucy loyally bore privations and separations, and herself became a paid worker, so as to help to provide for their children, and to ensure the fame and recognition which she never doubted.

In the next section—Audubon the naturalist—we have the account of his various explorations, extracts from his diaries, certain aspects of the controversies in which this pioneer ornithologist and artist was involved, sidelights on his contemporaries, the account of his ultimate triumph and recognition, and his subsequent work, aided now by his sons. There are several appendixes: original documents; birds of America; likenesses of Audubon; a very full bibliography, and that most useful feature, a careful index.

The illustrations include likenesses of relations and contemporaries, scenes from the homes of Audubon and many reproductions of his pictures, from the early simple drawings to the splendour of the decorative colour plates. This great innovation, namely, the representation of birds and animals in life and motion, in something approaching natural habitat, obtained favour in America only after England, Scotland and France had recognized its charm and value. Prof. Herrick does not omit to pay tribute to the great part played by Havell, the engraver. The large size of the plates, some of no less than five square feet, entailed the most skilful combination of aquatint with etching and line engraving. It was indeed fortunate that the pioneer artist and naturalist should have found a coadjutor of like courage and enterprise.

In biography, romance makes a good servant, but a bad master, and it is well to have this scholarly and critical presentation of a personality and life-history so unusual as almost to invite exaggeration.

E. G. G.

The English 'Open Field' System

The Open Fields

By C. S. and C. S. Orwin. Pp. xii + 332 + 29 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 21*s*. net.

THE layout of the countryside of England as we see it to-day is a very recent development; even the strict four-course rotation that in many places preceded it, and which is often regarded as the real old English system of farming, lasted but little more than a century. The system that had the long life in England was the one associated with the open fields. It comprised two distinct features: sub-division of the land among those entitled to share in it; and a rotation which usually consisted of winter corn: spring corn: fallow: it is thus described by Tusser in 1573:

> First rie and then barlie the champion saies
> Or wheat before barlie be champion waies:
> But drinke before bread corn with Middlesex men,
> Then lay on more compas, and fallow agen.

Although the land was very much sub-divided, the cropping appears to have been usually consolidated, and the total area of arable land of the village was set out in three fields, each devoted wholly to one part of the rotation. Each field was divided into small areas which were allocated to those entitled to receive them, but each man's holding was scattered over all three fields: each could, therefore, in principle, receive his share of good and of poor soil. The land was left open, unenclosed by hedges: the system is therefore called the 'open field system' and the process of bringing it to an end was called 'enclosure'.

Mr. and Mrs. Orwin have rendered splendid service to all interested in the history of the countryside by drawing up a full and detailed account of the working of the system in the ancient Nottinghamshire village of Laxton, of which, fortunately, unusually full records have been preserved and where, indeed, part of the system still survives. Their book thus becomes valuable source material; and the copious extracts from the old documents, and a complete transcription of the "Booke of Survaye" of 1635, give it unusual value for those who wish to acquire more than the usual sketchy knowledge of the subject.

Experts will be particularly grateful for the useful account of the management of grazing for livestock under this system. Grazing was, of course, very inadequate, and much slaughtering and salting down had to be done round about Michaelmas, because there would be no food for the animals during winter: to quote Tusser again:

> At Hallowtide, slaughter time entereth in,
> And then doth the husbandman's feasting begin:
> From thence unto Shroftide kill now and then some,
> This offal for houshold the better wil come.

But it was always obvious that some provision had to be made for what farmers call 'winter keep', and the authors show how this was done.

The extensive quotations from the records of fines throw valuable light on the agricultural and general life of the village: indeed the whole range of country life in England in the seventeenth century is illuminated by the well-chosen extracts.

The origin of the system is still obscure. Part of the system, the sub-division of the land and the scattering of the holdings, was widely spread around the Baltic; it is still in use in Poland; it has not long been displaced in Russia; also it is still practised in Northern India. The rotations also showed some resemblances to those used in England, but consolidation of cropping was not so common, and is not usual either in Poland or Northern India, except where some special circumstance has necessitated its adoption.

The system had the advantage of permanence, and there is no evidence of soil deterioration throughout all the years that it was practised. Also it accorded with the peasants' fundamental rule of husbandry, 'safety first': for if the crop on one of his strips was bad there was always the possibility that the yield on another might be better. But it had the grave disadvantage that yields were low and improvements extremely difficult: only when the scattered holdings were brought together into one piece could better methods be used. In England this process of consolidation began in Tudor times, and was continued almost to our own day. In Russia it was achieved after the Revolution under the name 'collectivization': in Poland, France (where necessary) and India it goes on more gradually and by persuasion.

The system can find no place in modern country life. It belongs to the old village life: the days of the craftsman, of folk dances and folk songs, of the old feasts and fairs, but it has passed. One cannot regret it, because it could not produce food in sufficient quantity or variety to maintain the village population in health. But it has left its mark deeply on the countryside: indeed the plan of the village to-day is frequently in the main lines almost the same as when the system was in operation.

E. J. RUSSELL.

Growth of Astronomical Thought

A Hundred Years of Astronomy
By Reginald L. Waterfield. (The Hundred Years Series.) Pp. 526. (London: Gerald Duckworth and Co., Ltd., 1938.) 21*s.* net.

MR. WATERFIELD has undertaken a very heavy task, and has produced an interesting and useful work. There are, especially in the United States, many text-books of 'descriptive' astronomy, with formulæ, diagrams, and (sometimes) excellent illustrations. This is something quite different. Its production has evidently entailed a very considerable amount of research into historical questions, and yet it is not by any means purely a history. The layman will probably feel, after a first reading, that there is an astonishing amount of astronomy of which he had scarcely heard, but which appears, on the whole, to be within his powers of comprehension, and is fascinating in its interest, once it is grasped. For the author has set out to describe not merely the development of knowledge but also the development of understanding; he sketches the processes of thought, the conflicting evidence, the puzzles, and their solution (when it has been attained), and he outlines present knowledge and speculation in a very readable way. Such a question as the motions of the stars as a whole might seem poorly suited to exposition for the lay mind, with no formulæ and practically no technical terms allowed; but by an apt use of analogies from everyday life, Mr. Waterfield does, in fact, hold the various classes of motion distinct in the reader's mind, and guides him, if he has a reasonably strong determination to follow, through a maze that was largely uncharted even by professionals at the start of the present century.

Mr. Waterfield is an amateur astronomer, and astronomy is pre-eminently the science in which amateurs always have distinguished themselves. On topics that usually interest amateurs most, he may be taken as authoritative; such matters as physical observations of the planets, the behaviour of long-period variables, and the construction of telescopes, may fairly be expected to be competently handled, and in fact dynamical and statistical astronomy are at least as well treated. It must, however, be added that he is less sound on the details of astrophysics, atomic theory, and also fundamental astronomy. The errors are as a rule not of a nature to damage the whole presentation seriously, but they are more numerous than one would wish.

The book also suffers from some defects in arrangement, especially in the earlier chapters. The author describes it himself as "at first sight somewhat chaotic", and it must be said that it does not improve with acquaintance. "Wireless Time Signals and Stellar Evolution" is perplexing as a chapter-heading; so is "Solar Physics and the Motions of the Stars". The arrangement is apparently due to an attempt to group together questions that arose at the same time; but even so the author is not consistent, since "Stellar Evolution" is allowed to run right on to the latest developments in curved space. The later chapters are better in this respect. There are other signs of inadequate revision, but it should perhaps be said that the author can in fact plead that at the time he was seriously hampered by circumstances beyond his control.

Perhaps in a second edition, which it is much to be hoped will be called for, these superficial blemishes may be rectified. The book as a whole is altogether too good to be judged by its defects.

R. d'E. A.

Vanishing Tribes of India

The Travancore Tribes and Castes
By L. A. Krishna Iyer. Vol. 1. Pp. xxi + 277 + 60 plates. (Trivandrum: Government Press, 1937.) 7 rupees.

IT was the ardent wish of that veteran ethnologist, L. K. Anantakrishna Iyer, to complete the survey of South India with volumes on Coorg and Travancore. His work in Coorg was cut short by his death, and it is fitting that the Travancore Survey should be entrusted to his son. Wisely the Travancore Government decided that first attention should be given to the hill tribes, whose social and religious institutions are fast vanishing. Only seven of these tribes are dealt with in this volume, which repeats and amplifies the admirable synopses of the Census Report for 1931, based on the author's notes.

Of the seven tribes, three are assumed to be offshoots of Hinduized communities well known in the plains, the Kuravans, the Pulayans and the Vedans. The Hill Pandarams, who number only

187 souls, may be kinsmen of the Paliyans of Madura and Tinnevelly, the most primitive folk in South India. Of very different status are the Kanikkars of South Travancore, a well-knit community more than 6,000 strong, with a wealth of traditional lore, the Mannans of the Cardomom Hills (1,276) and the Hill Arayans in the woodlands to the west of them (3,182).

The pivot of tribal life in India—social, economic and religious—is the 'clan' (*ilam*, 'house', in Malayalam), a group of families so closely related that marriage between them is considered incestuous; 'brothers' they are called (*annan-tambi*), as distinguished from 'in-laws' (*machambi*), groups with whom marriage is permissible. Sometimes the marriage law is simplified by grouping the clans into 'moieties', each of which must take its brides from the other. The limits of the marriage circle and prohibited degrees may vary from time to time and from place to place, but the distinction between 'brothers' and 'in-laws' is clear cut.

Thus the clan lists of the Kanikkars differ in the five different areas for which they are recorded, yet most of the clan names are common to more than one locality, and in each area they are grouped into moieties. Similar social patterns are found among the Mannans and among the Arayans, Kuravans and Vedans, of the hills.

Mr. Krishna Iyer's account of the clan systems of these people, with their local variations, is a big advance on the hasty generalizations of his predecessors, but the picture is far from complete. Evidence is lacking of the relations of the Kuravans and Vedans of the hills with their namesakes in the plains; of the Pulayans, Pandarams, Kanikkars and Mannans with their kinsmen and neighbours across the border, in British India. The map, reprinted from the Census Report, excellent so far as it goes, shows but a fraction of the places named in the text; a separate map for each tribe is essential.

It is to be hoped that in future volumes greater care will be taken with proof-reading and the transliteration of proper names, and with the printing of the plates.

'Civilization' spells ruin to these tribes. The drop in 'tribal religions' from more than 28,000 in 1901 to less than 3,000 in 1931, is not solely due to deaths; a few of the tribesmen have turned Christian, the majority are now registered as 'Hindu'. It is their solidarity that is decaying, the social autonomy which controls morality and is the traditional right of every Indian community. The Travancore Government are alive to the problem: with the facts now before them they may stop the rot. F. J. R.

Foundations of Nutrition

(1) The Foundations of Nutrition

By Prof. Mary Swartz Rose. Third edition. Pp. xi+625+2 plates. (New York: The Macmillan Co., 1938.) 15*s*. net.

(2) A Laboratory Handbook for Dietetics

By Prof. Mary Swartz Rose. Fourth edition. Pp. xi+322. (New York: The Macmillan Co., 1937.) 12*s*. 6*d*. net.

(3) Food Tables

By Prof. V. H. Mottram and Dr. Ellen M. Radloff. Pp. 63. (London: Edward Arnold and Co., 1937.) 5*s*. net.

(1). WHETHER dealing with the early history or tracing the latest developments of the science of nutrition, Prof. Mary Swartz Rose's book "The Foundations of Nutrition" is a delight to read and distinguished by its clarity and vitality. In these days of specialized work on the chemistry of foodstuffs, it is salutary to look back as Prof. Rose has done.

We tend to forget that Lavoisier and La Place made the first calorimeter and measured the heat evolved by animals and the oxygen consumption and carbon dioxide output in man. With improved apparatus Regnault and Reiset discovered that, in proportion to their size, small animals use more oxygen and give out more carbon dioxide and heat than larger animals. Next Bidder and Schmidt found that for every species of animal when no food is taken there is a typical minimum metabolism—our basal metabolism—varying with age, size and sex. Then followed Voit and Pettenkofer, and Rubner, who established the law of conservation of energy for the living body. Rubner observed also the extra heat produced by food, the greatest with meat—the specific dynamic action. By means of perfected respiratory chambers, Atwater, Rosa and Benedict established the equivalence of *direct* calorimetry, by heat measurement, with *indirect* calorimetry calculated from the gaseous exchange. Portable apparatus could then be designed for the easy measurement of energy metabolism. Regarded as a machine, man could have his energy expendi-

ture measured under every condition of life. At rest and without food his basal metabolism averages 1 calorie per kgm. of body weight per hour and is doubled by moderate exercise. Unexpectedly, an hour's sweeping with a vacuum cleaner expends 2·7 calories per hour as compared with 1·4 with a hand broom and 1·6 with a carpet sweeper. Such data make it possible to tot up the caloric expenditure of families and nations, and to ration armies and civilian populations in emergencies.

But food is not merely fuel for the engine. Food in its relation to growth and health has to be studied separately. One essential is protein. Consideration must be given to the so-called complete and incomplete proteins. Experiments on man have shown that the daily requirement of mixed protein is 1 gm. per kgm. of body weight.

Few books have such an admirable account of the mineral requirements of the body. Most work on this aspect of nutrition has been done in the United States, particularly by Sherman, who recommends for the adult man 1·32 gm. phosphorus, 0·68 gm. calcium and 15 mgm. of iron per kgm. of body weight per day. Women during pregnancy and lactation and also children need much more. Prof. Rose prefers to give the quantities per 100 calories of food, and shows pictures of portions of common foods which supply these amounts. There are so many ways of expressing quantities that it is difficult to say which is the best.

The thoroughness and impartiality with which the supply of each vitamin is considered is an example to those of our British dietitians who lavishly prescribe the fat-soluble vitamins and provide the others in sub-minimal amounts, especially neglecting vitamin B_1, the cheapest and easiest to provide. Prof. Rose is not content with their provision in anything less than the optimal amounts. The chapters on vitamins are up to date. Flavin is recognized as vitamin B_2. The latest finding of nicotinic acid as a cure for pellagra came too late for publication in the book.

(2) and (3). Data of food analyses and calorie values are indispensable for the dietitian. Prof. Rose's "Laboratory Handbook" contains a summary of food requirements, eleven practical examples in dietary calculations, 250 pages of tables of figures and a helpful note on planning a dietetic laboratory.

"Food Tables", by Prof. V. H. Mottram and Dr. Ellen Radloff, gives in a handy form a collection of analyses of British foodstuffs. Although these authors advocate the exclusion of figures beyond the decimal point, they have not had the courage of their convictions and retain the original figures to three places of decimals.

Both books include figures for the calcium, phosphorus and iron contents of foods. Prof. Rose gives many vitamin values in Sherman units. Mottram and Radloff prefer to wait until more vitamin values can be expressed in international units. The data in these books represent years of tedious analytical work and innumerable calculations. The student and dietitian now have all this labour done for them and should be duly thankful.

With all this knowledge so easily available, the obliging food manufacturer may in the future print on the labels of his cans the analyses, calorie and vitamin values of the contents. Eventually we may live on one perfect tin a day!

Plant Culture without Soil

Soil-less **Growth of Plants**:
Use of Nutrient Solutions, Water, Sand, Cinder, etc. By Carlton Ellis and Miller W. Swaney. Pp. 155 + 1 plate. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1938.) 13*s.* 6*d.* net.

THE growth of plants in liquid media instead of in soil is a method that has been much used in laboratory work for many years. For experimental purposes the method has the great advantage of permitting close control of environmental conditions and of food supply, to a degree that is impossible when soil is used. For some purposes the combination of nutrient solution with an inert substratum, such as sand, forms a useful modification. Much of the conclusive work on the importance of 'trace' elements in the economy of plants could scarcely have been carried out without the use of water culture methods.

Comparatively recently, attempts have been made to develop these methods from the commercial point of view. A most expensive item in the glasshouse cultivation of crops is the periodical removal and replacement of the soil, and it is claimed that growth in solution or sand culture would greatly reduce these costs if satisfactory equipment and technique could be evolved. Californian workers state that considerable success has already been attained; but so far as other

countries are concerned, the method is still in its preliminary stage. It must be recognized that success in developing the necessary technique depends on the close co-operation of skilled engineers and expert plant physiologists, and as yet the ordinary commercial grower, however skilful, is not in a position to make an economic success of the method. As it happens, premature press publicity has attracted much popular attention, and in some quarters has raised undue hopes of revolutionary crop production.

Information on soil-less growth is much scattered, and C. Ellis and M. W. Swaney have now provided a useful summary, written primarily for the non-scientific reader, but embodying details of use to the biological worker. The various examples quoted demonstrate the elasticity of the various methods, but deal only with successful cultures, tending to gloss over the possibility of failure. At least one of the quoted culture solutions should have been omitted in an elementary work of this nature, as concentrated acids are dangerous when used by inexperienced workers. The assumption, throughout the book, that algæ and fungi are identical is inexplicable and misleading.

One of the most useful features of the book is the demonstration that elaborate equipment and expensive chemicals are unnecessary for the amateur who desires to attempt a novel method of horticulture. All kinds of vessels can be adapted for use, and the nutrients obtained from any chemist. The general outlines of the function of the major and trace elements in plant growth, the action of hormones, ethylene and plant stimulants and the notes on diseases and pests are all helpful to the non-technical reader.

It is much to be hoped that at a later date, when a new edition is required, the needs of the scientific worker and the large-scale commercial grower will be met by a full discussion of the position, with a frank and critical comparison of types of equipment and appropriate nutrient solution for the various crops. There is no one optimum solution, which can be maintained as a commercial secret, and there is much to be gained by a general pooling of information in an attempt to ascertain whether the method of growth without soil has a real future from the commercial point of view, as well as for fundamental laboratory investigation.

Forest Management in Great Britain

Practical British Forestry

By C. P. Ackers. Pp xviii + 387 + 14 plates. (London : Oxford University Press, 1938.) 15*s*. net.

THIS book bears the imprint of the practical man and is based on the experience of an owner of woodlands during thirty years of management of his own estates. In his preface, Mr. Ackers alludes briefly to the training he went through to prepare himself for the work he has since carried out. In a foreword, Lord Clinton, himself no mean forester in connexion with his own woodlands, says, "It seems safe to predict that with the greater interest in forestry which is apparent to-day, a practical book upon the subject should meet with a very ready demand".

Lord Clinton points out that there has always been a tendency to criticize the system of management as practised in Great Britain. He admits that on many private estates no system exists and that often species are not suited to soils and environment. In consequence, the owner receives no regular income from the forestry portion of his estate and holds the opinion that forestry cannot pay. The author tells us that from the outset he had to regard forestry as a purely business proposition. He gives us an instance: "I held the opinion and still do that the art of raising high-class nursery stock has a bearing in many aspects on the problems of growing first-class woodland produce. I also felt that to do really well the grower should realize some of the tribulations and aims of the timber merchant. . . . With the object of correlating some of these ideas I now have 30 acres of commercial nurseries, some 2,000 acres of commercially-run woodlands and a sawmill utilizing some 1,000 cubic feet of timber a week. The nursery and sawmill were formed with a minimum of capital and have to pay their way or be closed down".

Space will not permit of following the author in great detail. Following an introductory chapter, two chapters are devoted to the hardwoods or broad-leaved trees and conifers or soft-wood trees, the sylviculture of the most important species being treated in a general manner, the chief pests being mentioned and the chief uses to which the timber is put. Other chapters deal with damage by the elements, vermin and so forth ; nursery work ; planting and establishing ; thinning and

pruning; extraction, conversion and sale of timber; sylviculture, minor forest produce and miscellaneous, in which various forestry operations are discussed; and a chapter entitled "The Future" in which such matters as taxation on forestry lands, conservation of our forest resources, future supplies, and so forth, are dealt with.

It is a pity that the author should have discussed working plans (Chapter xl, iii. Miscellaneous), the preparation and *raison d'être* of which he obviously misunderstands. A working plan for a forest area is not necessarily confined to "Universal High Forest"; nor are working plans of necessity subject to "regular fellings of areas identical in acreage year in year out, decade after decade, century after century". The provisions of a working plan are drawn up as the objects of management of the owner, whether State or private proprietor, prescribe. A plan can be prepared for 100 acres of coppice with an annual or periodic yield, as well as for high forest on a long rotation. The object of placing an area of woods under the provisions of a working plan is to safeguard it from the possibility of irregular fellings, when money is wanted, and poor management which produce the state of affairs the author's book is designed to improve.

Mr. Ackers is to be congratulated on his treatment of "Sport and Modern Forestry" (Chapter lx). It is possibly the best exposition of a widely misunderstood subject amongst landowners in this country which has ever appeared in a modern book devoted to British forestry.

Science and Practice of Brewing

Brewing: Science and Practice
Vol. I. Brewing Materials. By H. Lloyd Hind. Pp. xiv + 505 + 27 plates. (London: Chapman and Hall, Ltd., 1938.) 50*s*. net.

A LONG-STANDING hiatus in English scientific and technological literature would seem to have been filled at last by the work of which the first part is now under review.

The realization, growing extremely rapidly during the last fifty years or more, that the art of brewing has a strictly scientific basis, has led a number of investigators in all parts of the world to inquire into the fundamentals and the details of the processes involved. As in other fields of research, a marked acceleration in the output of original papers is to be observed since the close of the Great War, and it has been the lament of many English readers interested in brewing, that there are few, if any, books in the language which convey an adequate idea of the present position of brewing science and practice. Nor do German text-books, for example, completely bridge the gap, since Continental practice differs in many respects from that in vogue in Great Britain.

The present volume is concerned with materials, and, following an interesting historical introduction, is divided into six main sections devoted to barley, the biochemistry of malt and wort, malt, sugars, hops and brewing waters.

The section on barley is extremely well done and serves to indicate the importance of the work of the geneticist in this field, and the valuable results accruing from a systematic study of the biochemistry of the raw material of the industry The work of Bishop in this connexion is well known in brewing circles, but even so it is of considerable value to have a succinct account of a number of papers which appeared originally in the *Journal of the Institute of Brewing*.

From considerations of protein and carbohydrate composition of barley, and prediction of extract, we come to the next section, on the biochemistry of malt and wort. This may be regarded as a somewhat extraordinary feat of compression, since in some seventy pages the author has discussed colloids, hydrogen ion concentration, carbohydrates, proteins and enzymes. Clearly he has been in some difficulty here, as he has had to cater for some technicians who may not be familiar with certain scientific conceptions of which others may be well aware. When a second edition of the book is called for, it might be advisable to place this section first in order to pave the way to the section on barley and to preserve the continuity. The sub-section on carbohydrates might also be revised and slightly expanded for the sake of clarity.

Following this digression, the main outline is again followed with a full account of malt, its constituents and analysis and the interpretation of the latter. Analysis as an aid to the valuation of barley and determination of quality in malt has made large strides in recent years; but when the analyst has done his best (or worst, according to viewpoint) there still remain factors which in the judgment of many technicians may only be assessed in the light of experience.

In the case of sugars, as in the next section, the analyst is on safer ground, since now he is dealing not with the complex products of plant growth, but with much simpler substances obtained by more or less drastic treatment from the natural source.

With the next section, on the hop, we return to the natural product, and the treatment follows somewhat the same lines as in the case of barley. Indeed there are parallels between the work on these two materials: the nitrogenous constituents of barley have been the foremost objects of attack, whilst those which determine the preservative value of hops have been most investigated. Again, the work of the geneticist on hops has produced results comparable in importance with those obtained for barley. Thanks to this type of investigation, hops of extremely high preservative value are now being produced and marketed.

The concluding section deals at length with water supplies, brewing waters, the influence of salts and the general treatment of brewing liquors. On the technical side, the importance of the correct type of water for any particular process or product is not easily exaggerated; on the more academic side, the relations between the constituents of waters and the colloidal systems involved in malting and brewing provide a fascinating study for the physical- and bio-chemist alike.

The book is well produced in large type on good paper; references to many modern papers are given at the end of each chapter, whilst author and subject indexes terminate the volume. The author is to be congratulated on the successful issue of what must have constituted a difficult and laborious task. We look forward with interest to the second volume, on brewing processes.

Advances in Biochemistry

Annual Review of Biochemistry
By James Murray Luck and Carl R. Noller. Vol. 7. Pp. ix+571. (Stanford University P.O., Calif.: Annual Reviews, Inc., 1938.) 5 dollars.

THE "Annual Review of Biochemistry" appears for the seventh time, a little late this year, no doubt in spite of the efforts to ensure an early appearance; three reviews previously announced have not materialized. The academic success of the venture, by which we mean the utility to workers in this ever-widening field, has led its sponsors to enlarge their activities by proposing to publish as a companion volume an "Annual Review of Physiology", which will be a joint undertaking with the American Physiological Society. It will be possible to avoid duplication and make the two reviews mutually supplementary.

The intensive culture of high-yielding crops under conditions which render them very vulnerable to insect attack has brought to the fore the question of their protection, and hence as a topic of timely nature the volume includes a review by F. B. La Forge and L. N. Markwood, of the Bureau of Entomology, Washington, on organic insecticides of plant origin, which includes the rotenone group, pyrethrin, quassin and nicotine. There is considerable progress to report in the knowledge of the structure of these compounds, the method of their application and their testing. This review would have been of wider value if it had been more general in character.

The enzyme section, appropriately contributed by J. H. Northrop, is now proudly headed "Crystalline". Three new enzymes—ficin protinase, catalase and papain—have been isolated and crystallized last year, the protein of reductase has been crystallized, also the coenzyme of carboxylase. The total of crystalline enzymes has now reached ten. Even so, the preparations may contain more than one protein.

The carbohydrate section, by E. F. Armstrong, is devoted to the question of the structure of cellulose and starch, materials which though so different in appearance, as in behaviour, are both entirely composed of glucose molecules. Within the space available a readable account is given of this most difficult problem.

The chapter on proteins by Max Bergmann and Carl Niemann rightly stresses the renewed interest in protein chemistry arising out of the question whether the biological activity of enzymes, hormones, viruses and toxins, all of which are proteins, is to be attributed to some unknown prosthetic group or to the intrinsic nature of the protein molecule itself. It is recognized that the knowledge of the chemical molecule of the protein molecule is of primary importance, far more so than physical chemical measurements made with impure materials.

In reviewing progress in relation to hormones, O. Wintersteiner and P. E. Smith rightly select one or two sections for fuller treatment, namely, the hormones of the adrenal cortex, testis and

ovary. Similarly, the vitamins are divided into three articles, the first, by R. A. Peters and J. R. O'Brien, is restricted to the B-group; the second, by Peters and H. W. Davenport, to the C-group, whilst a third, by J. C. Drummond, deals with the fat-soluble vitamins. In this way satisfactory stories of high interest are produced, and this method of treatment should be insisted on by the editors in all sections.

As showing the interest even in such a highly complex and special subject as the terpenes and saponins, which are off the fashionable track of biochemical research, it is stated that five hundred papers have been reviewed in chemical abstracts during the last four years. This year's article is by W. A. Jacobs and R. C. Elderfield, who strive to make clear the complex structure to the understanding of which they have contributed so much themselves.

Sufficient has been said to show how adequately the reviews present the subject of biochemistry. As it grows, they form the only means of maintaining any kind of contact with it for many of us. It is well, therefore, to urge upon the editors that they should err, if necessary, on the more general and descriptive side, with an appeal to many, rather than be highly specialized for the few workers who in fact are of necessity forced to maintain touch with the literature as it appears week by week.

Practical Organic Chemistry

Laboratory Manual of Organic Chemistry
By Prof. B. B. Dey and Prof. M. V. S. Raman. Pp. xii + 158 + xlv. (Madras: G. Srinivasachari and Sons, 1937.) 7 rupees.

IF one were to try to find any cause for adverse criticism of this excellent book, it would be that it fails to suggest to the student the need for reading the original literature on the subject, and fails to provide him with any help should he wish to impart some human interest into the dry details of experimental manipulation. It is true that names are not entirely omitted, but it is difficult to find any references by which the worker can be guided to the place where first-hand details are to be found.

Even now some teachers of chemistry do not recognize to the full the value, both psychological and chemical, attached to the human association of discoveries with their discoverers. Surely there is nothing more fascinating than to read the story of the sugars as told by Fischer, or the synthesis of nicotine as told by Pictet. Something of the glow of accomplishment which must have been experienced by them still clings to the written description of it and imparts some of the thrill they felt to the reader. Even in the elementary sections of the subject, organic chemists can gain nothing but good by reading the original literature, and to the advanced student it is absolutely essential.

The book under review is divided into two parts. Part I, it is stated in the preface, "is intended to fulfil the requirements of the elementary student, while Part II should be suitable for the advanced students". A praiseworthy feature of Part I is the detailed description of many of the more important and more commonly recurring organic compounds, whereby the student can make himself acquainted with the actualities of these substances. It happens, not infrequently, that a student by failing to visualize the actual character of organic materials fails to appreciate the realities of the science. Obviously the practical method is the best in all cases, but sometimes this is difficult of accomplishment, for lecture specimens are often "nur Kochsalz und Wasser". In this section the apparatus described is admirably and clearly reproduced. One slight slip is noticed on p. 27, where the failure to indicate that the safety tube passes to the bottom of the steam generator may cause trouble.

The second part starts with some useful estimations which will be found of great service. There follows a short description of the methods by which a mixture may be investigated. This will be useful, but it has to be remembered that the bad old days of 'spotting' are past, and the most that can be usefully achieved with an organic compound is to assign it to its class. This point has been fully recognized by the authors, although it would have been better had the results of the analysis on page 48 been stated thus: "The mixture was therefore composed of a phenol and a phenol carboxylic acid. The former was shown to be β-naphthol and the latter to be salicylic acid".

The longest portion of this part is devoted to preparations. There is nothing striking about this section, but its inclusion is justified by the fact that any user of a handbook of this character must possess such information, and it is well not

to multiply the number of books required in laboratory work. There is a useful appendix.

The book is a good one, and both authors and publishers are to be congratulated on its appearance. It will be found entirely adequate by those who require a self-contained laboratory manual on organic chemistry. Nevertheless, there are many such books, differing from one another as the varieties of motor-cars. They are all made 'to go', and it seems to be the main duty of the reviewer to indicate that they will 'go' and to leave the user to choose for himself which particular variety suits him best.

J. F. T.

Asphalt : Bitumen : Pitch

Asphalts and Allied Substances :
Their Occurrence, Modes of Production, Uses in the Arts and Methods of Testing. By Herbert Abraham. Fourth edition. Pp. xxiv + 1491 + 7 plates. (London : Chapman and Hall, Ltd., 1938). 60*s*. net.

THE use of bituminous materials can be traced back to very early times, and the occurrence of natural asphalts had an undoubted influence on the course of civilization in Eastern countries. A substance which could be softened or liquefied by heat and with which solid materials could be incorporated had obvious practical uses in addition to embalming and sculpture. Perhaps the early civilizations of the Near East may be largely attributed to the possession of a constructional material which could be used as mortar in building, for road-making and, on account of its waterproofing qualities, for the construction of boats and baths.

The work under review first appeared in 1918, the second and third editions were issued in 1920 and 1929 (reprinted in 1932) respectively. The author is both a practical man and also president of the Ruberoid Co. and of Asphalt Shingle and Roofing Industry. In the preface to the first edition it is stated that "the author has taken it upon himself to draw freely from contemporary text-books and journal articles", adding that he has endeavoured "to place credit where it belongs". Inspection of the long bibliography and list of references suggests that the author has no cause to reproach himself in this respect.

The work is divided into six parts of unequal length ; the same remark applies to the thirty-seven chapters. The first part contains a very interesting historical introduction and also gives a classification and terminology for bituminous substances. The earliest use of asphalt is ascribed to the inhabitants of the Euphrates valley ; the remarks are illustrated by a map of the country from the Mediterranean to the Indus and by numerous photographs from recent excavations. Following the use of asphaltic materials through the centuries, it is mentioned that the first mastic pavement made with Seyssel (Ain) asphalt was laid in Paris in 1835, and London followed in 1836, whilst rock-asphalt from the Val de Travers was used for road-making in Paris in 1858.

With regard to terminology, the author is careful in defining the way in which he uses such terms as bitumen, mineral wax, asphalt, tar, pitch, etc. ; this is the more necessary as terms are used occasionally with different meanings. The materials dealt with are divided into four genera, namely, bitumens, pyro-bitumens, pyrogenous distillates and pyrogenous residues. The four genera are made up of ten species and the latter, in turn, of numerous members.

In the second part of the book the occurrence and handling of native asphalts receives attention ; needless to say, considerable space is accorded to the Trinidad lake. But although the author is an American, he affords quite a lot of space to the deposits in the Old World, illustrating his remarks with maps, photographs of mining operations and numerous analyses.

Tars result from (1) destructive distillation, for example, wood-tar, coal-tar, etc., (2) partial combustion as in the case of producer-gas and blast furnace tars, or, (3) 'cracking' operations. In Part 3 the author describes not only the more familiar tars but also devotes Chapter xix to fatty-acid pitch and bone tar and pitch. Considerable amounts of the former are obtained as by-product of the soap and candle industries and from the refinement of vegetable oils and refuse greases. Thus in refining cotton-seed oil, half a million barrels of 'foots' are obtained annually in the United States, from which the fatty acids are liberated and steam-distilled. Of the crude fatty acids treated thus, ten to twenty per cent appears as 'cotton pitch'. Such fatty-acid pitches find a ready use for cheap lacquers and japans, and they may also be converted into infusible masses by treatment with sulphur or a phenol and formaldehyde. Bone-tar pitch is produced in comparatively small amount but is used by varnish makers to deepen the colour of japans.

One large source of asphaltic material is afforded by the petroleum industry. Petroleums may contain asphalt, and even when they are non-asphaltic, asphalt may be formed during the distillation process. An interesting sketch of the cracking and refining industries is given in Part 4, plant used being illustrated by clear line diagrams. The discovery that petroleum asphalts may be converted into less fusible materials by partial oxidation has led to a large industry in blown petroleum asphalts.

The manufactured products and their uses are dealt with in Part 5 (280 pp.). A bituminous substance may be blended with other materials in order to modify its properties (fluidity, adhesiveness, tensile strength, etc.) and the compatibility of the added substance is of importance; this applies whether the added material is miscible or only a filler. Other 'mechanical mixtures' are the aqueous dispersions which have acquired so much importance for road-surfacing and which have many other uses. Of the industries in which bituminous materials are employed, special attention is paid to road-making and roofing-sheets and shingles (tiles). The thirty pages devoted to the latter includes directions for laying asphalt-shingle roofs, which some may consider outside the scope of the work.

Part 6, on methods of testing, occupies more than 400 pages and cannot be reviewed as it deserves in the space available. The directions given are usually clear, and each test has a number assigned to it. Since the test number is given for each determination in most of the numerous recorded analyses, doubt as to the method used in obtaining any particular result is eliminated.

Paper, printing and reproduction of illustrations (333) are good and, despite the size, the volume is not unwieldy. Spelling is American, to which the reviewer is accustomed and not averse. Misprints are few, those noted relating mostly to chemical formulæ and arising occasionally from misplacing or omission of brackets. Thus $Ca(OH)_2$ and $(CaOH_2)$ occur on p. 496, whilst on p. 509, $CaOH_2$ as well as $FeOH_3$ and $AlOH_3$ are to be found.

The book conveys the impression that the author found pleasure in writing it; this, in turn, reacts on the satisfaction of the reader.

Statistical Interpretation of Experiment

Statistical Physics

By L. Landau and E. Lifshitz. Translated from the Russian by D. Shoenberg. Pp. viii + 234. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 20*s*. net.

As a result of the many-sided developments of the last twenty years, the theoretical physicist has come to draw more and more upon statistical mechanics for the detailed interpretation of experimental results. On opening a recent book with the comprehensive title "Statistical Physics", one receives then at least a mild surprise to find that the subject is treated in an earlier manner, as a branch of mathematical physics divorced from any detailed connexion with experimental material. The authors evidently decided to give a concise and lucid treatment of a definite field, and they have fulfilled their intention admirably. Since in doing so they have kept within their chosen territory with an inflexibility that is unusual, it is desirable to mention the boundaries of this territory, without implying that these limits are unwelcome limitations.

In their preface the authors state that their aim has been "to give a unified presentation of thermodynamics and classical statistics, based on the point of view associated with the name of Gibbs; no attempt has been made at mathematical rigour in the treatment, since this is anyhow illusory in theoretical physics, but we have instead tried to make clear the fundamental physical assumptions on which the results are based". Having decided to confine their attention to classical methods, the authors adopt the reasonable point of view that the reader scarcely needs to be reminded of the existence of the quantum theory. When, for example, Dulong and Petit's law is derived, no indication is given that any progress has since been made in understanding the specific heat of solids; the subject is dismissed with the remark: "At low temperatures and for all complicated solids, the law is obeyed very badly." Even if one set out to write a book on statistical physics in which the electrical nature of matter was to be ignored throughout, and no known substances were to be mentioned by name, in these days care would be needed to prevent one's knowledge from slipping in unawares. In this volume there are two or three passages where chemical substances are mentioned. Apart from a passing reference to the size of the universe, only one experimental numerical value is mentioned, namely that of Boltzmann's constant.

In short, the scope of the book is to present the mathematical theory, giving a very readable exposition of the classical methods. The authors have exerted themselves to convert the Gibbsian raw material into a palatable form. To ensure that the underlying principles shall not be concealed by a notational undergrowth, they have devoted the first two thirds of the book to assemblies containing only one species of particle. They have provided more than fifty diagrams, illustrating various aspects of the theory; and scattered through the book are sixty examples—problems, for each of which the method of solution is given; these are a valuable feature.

The later chapters include a section based on Onsager's treatment of irreversible processes, and another section founded on Wagner and Schottky's theory of ordered solid solutions. A chapter on anisotropic bodies is based on Landau's own work published in the Soviet journals. R. W. G.

Epistemology and Anti-Metaphysics

(1) Critical Realism:
Studies in the Philosophy of Mind and Nature. By Prof. G. Dawes Hicks. Pp. xxiv + 346. (London: Macmillan and Co., Ltd., 1938.) 15*s*. net.

(2) A Basis of Opinion
By Adrian Coates. Pp. xvii + 461. (London: Macmillan and Co., Ltd., 1938.) 16*s*. net.

PROF. DAWES HICKS and Mr. Adrian Coates agree in their decisive rejection of any form of subjective idealism and in their vigorous repudiation of an idealistic interpretation of physics. They both expend much trouble upon criticizing various forms of sensum or sense-data theories; they are both concerned to deny that a sense-datum is an object, and they seek to draw important conclusions from this denial. They diverge, however, so widely in their respective conceptions of, and methods of approach to, philosophical problems that, even when they reach the same conclusions, the grounds upon which their acceptance of these conclusions are based are entirely different.

(1) The critical realism of Prof. Hicks is 'critical' in the Kantian sense of that word. He agrees with Kant in putting in the forefront of philosophical inquiry the attempt to answer the question *how* knowledge of objects is possible. His exposition of Kant's point of view is singularly clear and helpful. He further agrees with Kant in holding that knowledge of objects involves both sensuous and conceptual apprehension. But he discerns the weakness that led Kant to an unduly subjective view. Prof. Hicks directs his polemic mainly against the mistaken assumption that sense-elements are discrete units that must somehow or other be synthesized into the object perceived. He maintains that the sense-datum is not an *entity* (*etwas*) upon which the act of perceiving is directed (*gerichtet*). The erroneous assumption that the sense-datum is an object cognized is the cardinal error alike of Berkeley's subjective idealism and of those forms of contemporary realism that have been designed to avoid the difficulties of a representative theory of perception. If we once admit that there is a *tertium quid* (sense-datum or 'idea') "between the cognizing mind and the world of real existence", then we are driven to conclude either that the real object is unknowable or that the object known is "a *construction* on the part of the mind itself, a product of the mind's own making" (p. 5). I assume that a well-known view of Bertrand Russell's would be a variant of the second alternative.

Prof. Hicks utterly rejects such views. He replaces the notion of sense-data, or ideas, as *objects* by the notion of *contents*. There are three kinds of contents: the content of the object, the content apprehended, and the content of the mental act. Up to a point the distinction between these three kinds of content is made clear. Unfortunately, it is very difficult to know what exactly 'content' is used to signify, and why the same word should be used for the "content of the object" and "the content of the mental act". 'Content' seems here to be used as a synonym for "a way in which . . .", the gap being filled in a way appropriate to the object apprehended and the mental act of apprehending it. But "a way in which" stands as much in need of clarification as the word "content" that it is used to explain.

I regret that lack of space prevents me from discussing Prof. Hicks's theory in detail, since it well repays study. I must be satisfied with pointing out that he has provided good grounds for the view that colours, sounds, temperatures, force, energy, strain, etc., are not mental constructs but are contained within Nature; that in perceiving we apprehend more or less accurately sense-qualities which really are qualities of that which we perceive, that is, of material objects; finally, that mind is not to be set over against Nature. On all these points I should like to comment did space permit.

(2) Mr. Coates shares with Prof. Hicks his impatience of the philosophizing men of science. Unfortunately, he has not much tolerance of philosophers; he repudiates "as metaphysical nearly the whole course of philosophical speculation from the time of Thales to the present day" (p. 27). "The root fallacy of the metaphysician", he says, "consists in applying the categories of science outside the sphere where they properly belong, and in reducing the whole of existence to the form of the subject-object relation" (p. 29). Mr. Coates believes that the proper attitude of the philosopher should be that of the historian for whom the problem of appearance and reality, of subject and object, never arises in the form which this problem has taken in the philosophical tradition. The historian deals with persons knowing, acting, and feeling, one with another; he recognizes a plurality of persons in intersubjective intercourse.

The working out of this point of view occupies the greater part of the book. It is extremely well done. Mr. Coates is emphatic that a philosophy is a personal point of view. He is, however, more concerned to convert others than he is perhaps himself aware. The method of conversion is to induce acceptance of a common language. Perhaps Mr. Coates unduly simplifies the problem. At times he seems to suggest that if only you and I would agree to accept the commonsense usage of language as our norm, then our philosophical perplexities would be dispelled. "People exist; things are real" (p. 227). Accordingly, "existence is not subordinate to reality, but reality to existence".

How far does such a statement enlighten us? To know the answer to this question, it is necessary to read Mr. Coates's book. Whether one agrees or not with his point of view, it must be admitted that Mr. Coates has written an interesting book and has much that is important to say with regard to the relation of language and logic.

L. SUSAN STEBBING.

Indian Realism

Indian Realism

By Prof. Jadunath Sinha. Pp. xvi + 287. (London: Kegan Paul and Co., Ltd., 1938.) 10*s*. 6*d*. net.

THIS is no simple exposition either of the doctrine of the Yogacara *Vijnanavada* or subjective idealism, or of the criticisms of the doctrine by the different schools and representatives of Indian realism. The arrangement of the text is so confusing that although the book would probably be an excellent accompaniment for the student who is preparing to read the original texts for himself, it is emphatically not a work for the philosophically minded reader who wishes to be orientated in traditional Indian philosophical thought. To begin with, the exposition is presented in a very complicated form. The co-ordination is faulty, there is no summarizing to help the reader; and it is difficult to disentangle the author's own comparisons with the views of European realists, where these occur. However, once the student has straightened out this confused presentation and has managed to ignore the unnecessary repetitions of Sanscrit terms, he will find that he has acquired a good deal of valuable knowledge on the subject.

In the opening chapters, Madhavacarya's account of Yogacara subjective idealism is followed by a reconstruction of the doctrine from the works of such typical exponents as Santaraksita and Kamalasila, whose arguments against the existence of external objects have not apparently been given in any other works dealing with Yogacara idealism.

The Yogacara arguments may, in general, be divided into two classes—epistemological and metaphysical. The epistemological argument shows that cognitions are self-aware and cannot apprehend external objects, of which, again, the existence cannot be proved; and the metaphysical argument consists in showing that the nature of an external object cannot be ascertained. Then in the following chapter, the arguments of the Sautrantika realists against the Yogacara doctrine of the non-existence of the external world is outlined by Madhavacara; while their own doctrine, which advocates a representationist theory of perception akin to that of Descartes and Locke, is expounded. This is followed by the counter-argument of Yogacara idealism against the Sautrantika representationist theory, which is set forth by Jayanta Bhatta; and an exposition by Sridhara of the Yogacara argument against the realist doctrines of the Sautrantika. Further expositions and criticisms of Yogacara subjective idealism by the Jaina, Sankhya Yoga, Mimasaka and Nyaya-Vaisesika realists, take up the succeeding chapters. Finally, the Vedanta critique of subjective idealism, in which the absolute idealism of Sankara is contrasted with the Yogacara subjective idealism, is set forth in the concluding chapter.

SHORT NOTICES

Agriculture

Mother Earth:
being Letters on Soil addressed to Professor R. G. Stapledon. By Prof. Gilbert Wooding Robinson. Pp. viii+202. (London: Thomas Murby and Co., 1937.) 5*s*. 6*d*. net.

THIS is an interesting and useful little book for the general reader. Although couched in the form of letters, the material apparently consists of the author's lectures to first-year students of agricultural science, omitting the more complicated diagrams and tabular matter but retaining the occasional shafts of professorial humour which relieve the tedium of yearly repetition—at any rate for the lecturer. There are seventeen chapters, or letters; beginning with a discussion of soil material, they pass to a description of soil profiles and surveys and their bearing on problems of soil fertility and the correct agricultural utilization of the various soil types.

Leguminous Forage Plants
By Dr. D. H. Robinson. Pp. vii+119. (London: Edward Arnold and Co., 1937.) 6*s*. net.

THIS little book is not primarily designed for the expert, but rather to enable the inexperienced to identify the various legume crop plants that are grown in Great Britain, and to explain their agricultural uses. It accomplishes its purpose very well and is written in a clear and readable style. The account of each legume commences with a description illustrated with excellent drawings. This is followed by a short outline of the crop's agricultural uses. A typical chemical analysis is given for most of the legumes described.

The book contains a few inaccuracies which might be corrected in the next edition. Thus it is not true to say that the nodule bacteria from red clover cannot infect white clover. The variation in efficiency of different strains of nodule bacteria is an important and widespread characteristic and is by no means confined to the organisms that infect lucerne. The discovery of such strain differences amongst the lucerne nodule bacteria is incorrectly credited to the reviewer. The problem of clover sickness appears to be less simple than is suggested on p. 18, and cannot always be attributed either to eel-worm or *Sclerotinia*. H. G. T.

Theory and Practice in the use of Fertilizers
By Dr. Firman E. Bear. (Wiley Agricultural Series.) Second edition. Pp. ix+360. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 20*s*. net.

THIS well-known text-book, first printed in 1929, has now been brought up to date. During the last nine years the subject has made great strides in its chemical, engineering, and agronomic aspects, and within the limits of a single book, it is only possible to touch lightly on some of these. The form of the book remains unaltered, but sections are added dealing with the inclusion of dolomite in fertilizer mixtures for use on acid soils; the use of granular fertilizers; the addition of calcium sulphate to high analysis mixtures; and the rapid methods of soil analysis for 'available nutrients' now being extensively used in the United States and elsewhere. A new chapter has been added on the minor elements in soils and crops, and examples of the necessity for the provision of traces of boron, copper, iron, magnesium, manganese and zinc are quoted, mainly from American sources.

Anthropology and Archæology

Other Men's Lives:
a Study of Primitive Peoples. By Sir George Dunbar. Pp. xiv+355+1 plate. (London: Ivor Nicholson and Watson, Ltd., 1938.) 10*s*. 6*d*. net.

THIS book is difficult to handle fairly. It aims at giving an account of the mode of life of a primitive people as it develops from the stage of the simple hunter and food-gatherer to that of the small farmer at the point of transition from the use of stone to that of metal. The author describes the culture of the old and the new stone ages, and then passes on to give an account in considerable detail of the culture of the extinct Tasmanians and of the Indians of North America, who may be said to be, in a cultural sense, no less extinct. The book is brought to a close with a description of the Abors, the little-known, and for long inaccessible, people living between the Assam valley and the Tibetan borderland. These people are taken as exemplifying in modern times a type of culture which has been shown to have existed in the stone age.

Setting aside the question how far a modern so-called primitive people presents an exact analogy with a prehistoric stone age people, from which it is separated by a gap of thousands of years, Sir George Dunbar's book appeals primarily to the non-technical reader, since neither his account of the Tasmanians nor of the Indians of North America is other than a compilation. At the same time, although he is not in the professional sense an archæologist, his account of the peoples of the stone ages interprets the material with the eye of an ethnographer with first-hand acquaintance of how a people of simple culture really does live. In the concluding section of the book, however, the author records the results of his experience during some years of residence among a people in a stage of transition from stone to metal. If on this account alone, his book deserves the attention of the scientific anthropologist.

L'Art des Iles Marquises

Par Willowdean C. Handy. Pp. 56+43 plates. (Paris: Les Editions d'Art et d'Histoire, 1938.) 75 francs.

MRS. HANDY, who in 1920–21 accompanied her husband, Dr. Craighill Handy, on the Bayard Dominick expedition of the Bernice P. Bishop Museum of Honolulu to the Marquesas, there devoted herself to the study of the tattooing for which the islanders have always been noted. Her observation of this practice, highly important both in its ritual and in its decorative aspects, has afforded her an exceptional insight into the artistic activities and conceptions of the people, of which she here gives an admirable summary, while analysing the highly conventionalized designs into their component motives. Of these motives the most important is the human form, a logical outcome of the idea, inherent in Marquesan thought, that to make anything is an act of creation, standing in definite evolutionary relation to the first act of procreation, by which Alea, the celestial father, fertilized One—u'i, the earth-mother.

In a brief comparative study, the author indicates her conclusions as to the relation of Marquesan art on one side to the archaic Maori art, with its divergent development owing to the technique of the chisel, and on the other to the art of ancient Peru, with which there are indications that there may be affinities.

Canoes of Oceania

By A. C. Haddon and James Hornell. Vol. 2: The Canoes of Melanesia, Queensland and New Guinea. (Bernice P. Bishop Museum Special Publication 28.) Pp. vi+342. (Honolulu: Bernice P. Bishop Museum, 1937.) n.p.

IN the second volume of this joint study of the canoes of Oceania by Dr. A. C. Haddon and Mr. James Hornell, the former has brought together and analysed an enormous mass of detail relating to the canoes of Melanesia and adjacent waters. It is drawn in part from personal observation, in part from published, or in some instances unpublished, observations of travellers and ethnologists, sometimes going back to the earliest recorded visits to the islands by Europeans. On the whole, this latter source is more satisfactory than the corresponding material under contribution in the preceding volume, which dealt with Polynesia.

The problem, or rather series of problems, of the canoe in Melanesia, to which, as is well known, Dr. Haddon has devoted many years of study, is infinitely more complex than that of Polynesia. Not only is there the question of modifications possible through contact in trade, etc., but also this region has been subjected to racial and cultural drifts which have left their mark on the canoe perhaps as much as on any other element in culture. This applies not only to general lines of construction but also to details, often, it might appear, of relatively little significance. Thus, for example, in the Massim area of New Guinea, which is remarkable for the decorative carving of its canoes, Dr. Haddon is able to discriminate between no fewer than four areas of difference, according to details of outrigger, sail, etc., while in the area of marginal communities in north-eastern Melanesia, south-east of the Solomons (Tikopia, Rennel, Ontong, Java, etc.), he shows how the canoes not only differ from those of their Melanesian neighbours, but also show traces of Polynesian and Micronesian influence, corresponding to differences in physique, language and culture.

Biology

Genetics:

an Introduction to the Study of Heredity. By Prof. Herbert Eugene Walter. Fourth edition. Pp. xvii+412. (New York: The Macmillan Co., 1938.) 12*s*. 6*d*. net.

IT is unfortunate that the fourth edition of this book should have been published in its present form. The earlier editions provided an interesting account of the work of the early investigators and reflected the influence of this work on the current biological thought. The present edition also contains much which is interesting from a historical point of view. The author's lack of appreciation of modern genetics is shown, however, by the description of crossing-over in the two-strand stage, the emphasis placed on Weismannism, the implication that the genes for sex are on the sex chromosome alone, and by the stress laid on the arbitrary division of genes into lethals, modifiers and other categories. Much loose thinking vitiates the praiseworthy attempt to express genetical facts in popular language. "Eugenics not Bluegenics", "The cytological approach tries to find out what is the make-up and behaviour of genes", "Translocations and deficiencies are bound to cause embarrassment later when *synapsis* takes place, because some of the *genes* in the *mitotic* dance become wallflowers without a partner", are some examples of phrases which might have been expressed differently. F. W. S.

The Way of Birds

By R. B. Talbot Kelly. Pp. 135. (London: Wm. Collins, Sons and Co., Ltd., 1937.) 25*s*. net.

THIS is a volume of large format, consisting mainly of coloured and other drawings—seventy-two in all—with a few lines of text about each. It is a book of birds as the artist sees them in life, and not of illustrations in which detail is carefully checked from museum specimens. In a short introductory chapter, called "Feathers", Captain Kelly expounds the difference. "I used to think that herons were always blue-grey in colour. But I have seen a heron look blue, and pale ash-grey, and purple-grey, and golden-buff in different lights at varying times of day. . . . The beauty of the feathered coat is that we perceive it as a whole; as a coherent, fluid vestment, not as a collection of separate feathers". On the other hand, "the scientifically accurate map-drawing of a bird's plumage pattern is a specialised form of art, or perhaps craftsmanship". A second chapter, called "Wings", discusses form and movement—particularly in flight.

The reader is thus prepared for generalized representations of colour patterns, and for unfamiliar shades seen in special lights. The test is severe, however, as the bird rendered static on paper becomes too readily comparable with the close-up appearance to which one is accustomed. So, while the method partly succeeds, the effect sometimes seems too strange to be credible. The difficulty is less with the black and white drawings which form the majority, as one's attention is focused on the movement which the pose has caught. The result is often beautiful and life-like. Captain Kelly has clearly a real feeling for his subjects: his work is evocative of pleasant memories and stimulating to fresh observation.

Chromosomenbau

Von Prof. Lothar Geitler. (Protoplasma-Monographien, Band 14.) Pp. vii+190. (Berlin: Gebrüder Borntraeger, 1938.) 15 gold marks.

THIS competent and up-to-date monograph on the morphology and behaviour of chromosomes provides an outline of the structure of the chromosome in plants and animals, based on recent work. After describing the external morphology of the chromosome the author discusses euchromatin and heterochromatin, the formation of spirals, chromomeres, the salivary gland chromosomes of Diptera, and the physico-chemical nature of chromatin. A comprehensive bibliography is given, while the illustrations are excellent.

This well-illustrated monograph can be highly recommended. F. W. S.

Chemistry

Laboratory Technique in Organic Chemistry

By Prof. Avery Adrian Morton. (International Chemical Series.) Pp. x+261. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 15*s*.

THERE are so many books on this subject that the publication of still another makes the reader wonder whether it should be a welcomed addition to those already in print or whether it should be regarded as redundant.

The answer in this case is clearly the former, because the book is not quite like anything that has appeared hitherto. Few books provide guidance in both the inorganic and the organic laboratories, and if one is asked is it altogether desirable that this should be so, the answer must be that circumstances alone can determine the needs of the moment. Certain it is that if one were to possess and to use all the knowledge in this book, he might be regarded as almost one of the universalists, the days of whom are said to have ceased with Odling. The changes which have taken place during the last forty years are really amazing, for if the number of types of apparatus required for research purposes at the present moment are compared with those needed in 1900, it is clear that in those days the manipulator had to rely mainly on his own skill in order to form the kinds of appliance he required. Now the manufacturers reproduce in a very short time any special form of apparatus details of which may have been provided by an investigator, and it is ready for use at comparatively small cost, by anyone who may wish to adopt it for some purpose of his own. The American practice of using the names of describers to denote any variations in types of apparatus is used freely in this book. It is an open question whether this is desirable or not, but in Great Britain it is generally regarded as invidious, because the work leading to the elaboration of any special type is so often the outcome of team work. Nevertheless, perhaps in several instances cited in this book the inventor's name should be associated with his creation. It will suffice to mention two cases of the kind which stand out from the others, namely, the amazing apparatus of Doran on page 92 and that of Quiggle, Fenske and Tongberg on page 54.

The book is a good one, and is to be highly commended to those who want a general treatise on modern chemical technique and all that that implies.

J. F. T.

Grundzüge der Theorie ungesättigter und aromatischer Verbindungen

Von Prof. Dr. Erich Hückel. Pp. 160. (Berlin: Verlag Chemie, G.m.b.H., 1938.) 6 gold marks.

THE appearance of pamphlets such as the one under review indicates, if any indication were needed, the necessity for students of chemistry, and particularly of organic chemistry, of possessing a working knowledge of German. The Germans write these short monographs so well, and the German publishers seem to like publishing them, although the profit must be small. In Great Britain there is a need for similar publications, but their sale is restricted by the fact that senior students (third year) rely nowadays almost entirely on their lecture notes.

The monographs, therefore, find their greatest use among the lecturers themselves and among the research workers who happen either to be personally interested or among those who wish to be kept fully up to date in the advance of organic chemistry. In these directions the monographs do great good, and in the present example the subject dealt with is one which may be said to be in the forefront of organic chemical discussions at the present time.

The saturated carbon atom, that is to say, one which has all its combining capacity satisfied or practically satisfied, is of less interest that the unsaturated atom in which such combining capacity is not satisfied. The discovery of Thomsen that the double bond in ethylene did not represent two single bonds gave an impetus to research in unsaturated carbon compounds which has led to fruitful work during the twentieth century. The cause of the striking differences shown by unsaturated compounds and those belonging to the 'aromatic' series is still the question of hypothesis and awaits the advent of an all-pervading theory. It is this field of organic chemistry that has been chosen to supply the substances used by Nature for the purposes of animal and vegetable metabolism, and there can be no

question that the problem of the chemistry of the life processes will be found to be based on them.

A knowledge of German provides, therefore, the student with the key to a door through which he can find much knowledge of the kind contained in this book. He would be wise to acquire it. J. F. T.

Handbook of Chemistry

A Reference Volume for all requiring Ready Access to Chemical and Physical Data used in Laboratory Work and Manufacturing. Compiled and edited by Dr. Norbert Adolph Lange, assisted by Gordon M. Forker. With an Appendix of Mathematical Tables and Formulas by Prof. Richard Stevens Burington. Second edition, revised and enlarged. Pp. xvi+1501+249 (Appendix)+30 (Index). (Sandusky, Ohio: Handbook Publishers, Inc., 1937.) 6 dollars.

FIRST published in 1934 (see NATURE, **135**, 978; 1935), this extremely useful handbook has now proceeded to a second and enlarged edition, containing nearly 1,800 pages of valuable and easily accessible information. Many of the tables have been revised while, in addition, there are sixteen new ones, the majority of which deal with the refractive indexes of solids and liquids. Another useful addition, and one which will prove of considerable aid in the identification of organic compounds, is the listing of the melting points of such compounds in order of ascending values. There has also been introduced a section on the numbering of ring systems.

Of the parts which have been revised or rewritten, mention may be made of the sections on first-aid, the nomenclature of organic compounds and, particularly, of that dealing with the use of organic reagents in inorganic analysis.

This handbook is handsomely bound and is excellently printed, the matter being clearly set forth without any appearance of overcrowding; there is also a very complete index. Altogether the book will prove serviceable to every chemist and be the means of saving much time which would otherwise be spent in a tedious search of the literature.

G. R. D.

Engineering

Electrical Measurements

By Frank A. Laws. (Electrical Engineering Texts.) Second edition. Pp. xiv+739. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 36*s*.

COLLEAGUES of the late Prof. F. A. Laws have seen the manuscript of the second edition of this text through the press, and have made sure that it contains the latest references and information which it is thought desirable to place before such undergraduate students as are looking forward to a career in electrical engineering. It is also intended to be of use to practising engineers who desire to understand the basis of testing technique which is found in practical work.

There is a great deal which the normal student does not need, and guidance from experienced teachers is therefore essential. There are also more extended references to the relevant literature than is usual; although it would be the teacher's delight if students could be induced to read original literature, it must be confessed that they would not be able to discriminate between various types of work and extract basic principles, for that is all that they have time for, from modern work, which is complex and possesses refinements obscuring the main idea.

The newer high-voltage cable tests are included, but there is little that can appeal directly to the electrical engineering student who intends taking up high-frequency communication work. The involved shielding of modern high-impedance precision bridges might have been made clearer, with larger scale diagrams.

Radio-Frequency Electrical Measurements: a Guide for Radio Engineering Laboratory Instruction

By Prof. Hugh A. Brown. Second edition. Pp. xvi+384. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 24*s*.

THIS text is intended to be the basis of a fourth-year radio engineering course for telecommunication engineers, and assumes a normal knowledge of electrical engineering and physics. It consists of a large number of approaches to specified measurements; in the new edition exact procedures are outlined for the more difficult types of measurement. The cathode ray tube, with linear time-base, is freely used, and measurements of modulation and the frequency drifts of quartz-crystals, when used with valves as frequency controls, are included. The standardized methods of ordinary measurements on circuit elements are numerous, and students would require a plan in order to make a useful selection.

The course seems more balanced than others recently published, none of the experiments being trivial and none beyond a post-graduate student or a development engineer. The art and technique of radio is advancing rapidly, but its advancement depends mainly on precise measurement. The present text offers good training in this field.

L. E. C. H.

Geography and Travel

Gales, Ice and Men: a Biography of the Steam Barkentine *Bear*

By Frank Wead. Pp. xiv+240+13 plates. (London: Methuen and Co., Ltd., 1938.) 12*s*. 6*d*. net.

"GALES, Ice and Men" is the history of what may be the last of the ice ships, the *Bear*, which had a long and honourable career from 1874, when she was built, to 1935, when she was laid up, perhaps finally. She was Newfoundland sealer, rescue ship (Greely, 1884), U.S. Revenue Service, with all that that entails in the far north Pacific, U.S. Coast Guard and finally, at the age of about sixty years, one of the ships of the Byrd Antarctic Expedition. The *Bear* was built at Dundee and almost certainly in the same yard as the *Discovery*, although Scott writes of "Stevens's" and Mr. Wead

of "Alexander Stephen & Sons". The two vessels are about the same size, but the *Bear* was a little narrower and had not *Discovery's* stern: the former showed perhaps rather better behaviour in dirty weather.

It is almost impossible to believe that there is no more scientific work for a ship built to withstand the ice, and it is therefore the more important that there should be preserved records, as minute as possible, dealing with the construction and performance of such vessels. If thirty-three years ago Scott could write that "it is all passing away", there is much more reason for apprehension now. Mr. Wead has written a sound book in a perfectly straightforward manner and is to be complimented on avoiding the dramatic. It is rather a pity that in the brief outline of Alaskan history he omits the name of the indomitable Baranov. J. E. H.

The Scenery of England and Wales

By Prof. A. E. Trueman. Pp. 351. (London: Victor Gollancz, Ltd., 1938.) 7*s*. 6*d*. net.

IN his opening sentence, the author points out that "In England and Wales we are singularly placed to appreciate the relationship of scenery and structure, for few other parts of the earth's surface show in a similar small area so great a diversity of rock types and of landscape features". In this attractive little book, addressed to walkers and motorists, as well as to students, an easily intelligible and pleasantly written attempt to stimulate that appreciation has been made.

Although, as a geologist, Prof. Trueman sees scenery from an anatomical point of view, as the external expression of internal structure, he does not omit to mention the softening influences of "waters blown by changing winds to laughter", or to exemplify the harmonious effects of native stone on the domestic architecture of the unspoilt countryside. Each chapter deals with one area or type of country, such as the Cotswold Stone Belt, the Pennine Moorlands, the Lake District, South Devon and Cornwall, and they are so arranged that the more complex regions come last.

The work concludes with "A Chronology of the Changing Scene" and a brief survey of the geological history of the varied landscapes and seascapes that have culminated in our present-day geography. In a future edition the very short appendix on maps and books might advantageously be amplified.

Geology

Landslides and Related Phenomena

a Study of Mass-Movements of Soil and Rock. By C. F. Stewart Sharpe. Pp. iv + 137 + 9 plates. (New York: Columbia University Press; London: Oxford University Press, 1938.) 15*s*. net.

IN this excellent and well-illustrated book the author covers the whole field of his subject by treating the phenomena, not as isolated processes, but as stages in two continuous series, "in each of which there is every transition from moving masses of dry rock and soil at one extreme to masses of rock and soil abundantly impregnated with water or ice at the opposite end of the sequence". The movements themselves are distinguished as flow (continuous deformation) and slip (mass movement along a plane separating the moving mass from the stable ground), and each type is further subdivided in terms of rate of movement. The classification thus arrived at is by far the best yet proposed, and has the great advantage of clearly relating the co-operating processes and resulting forms to those of the recognized geomorphic cycles.

Though brief, the book has a well-selected bibliography and is thoroughly comprehensive. Despite its high price, it is an indispensable work of reference that no geologist can afford to ignore.

Geologisches Wörterbuch, Erklärung der geologischen Fachausdrücke:

für Geologen, Paläontologen, Mineralogen, Bergingenieure, Geographen, Bodenkundler, Studierende und alle Freunde der Geologie. Von Dr. Carl Chr. Beringer. Pp. vii + 126. (Stuttgart: Ferdinand Enke, 1937.) 5.60 gold marks.

IN this German handbook of geological terms the definitions, descriptions and explanations are given briefly and in simple language. Where it has seemed desirable, illustrations are provided, and certain terms, such as *erzlagerstätten*, *faltungsphase*, *formationskunde*, *orogenese*, *schichtung*, are amplified by means of schemes of classification. In German-speaking countries, the book will be a useful guide to the "hard words and forbidding technicalities" of a subject which is much more attractive than its German nomenclature. In English-speaking countries, students of geology, geography and related subjects will find the book invaluable, whether they are learning to read scientific German or, at a higher level of ambition, attempting to cope with the growing flood of German contributions to geological literature. Clear explanations will here be found of many words for which hitherto they may have searched in vain.

Mathematics

The Principles of Mathematics

By Bertrand Russell. Second edition. Pp. xxxix + 534. (London: George Allen and Unwin, Ltd., 1937.) 18*s*. net.

MANY thinkers have regretted Bertrand Russell's desertion of the arid beauties of mathematical logic for the alluring dangers of practical ethics and sociology. This new edition of the "Principles of Mathematics" will be welcomed by them not only because it makes accessible to all a book which fetched eight guineas when a stray copy could still be found, but also for its preface which many might wish to consider as a 'return to mathematical logic'. This preface of ten pages shows, in fact, that Russell has never lost his interest in the subject. He tells us that he sees no reason as yet to modify his views on his fundamental thesis of the identity

of mathematics and logic; and he supports his opinions by a short discussion of the main contentions of the formalist and of the intuitionist schools.

An interesting admission concerns the status of logical constants, which "must be treated as part of the language, not as part of what the language speaks about" (p. xi). In this way, Russell believes, logic becomes much more linguistic than he believed it at the time when he first wrote his book. Another reflection concerns the theory of types, which the author still defends in its purpose to establish a set of rules for deciding whether a given series of words is or is not significant. Summing up his estimate of the progress of mathematical logic, Russell is of opinion that the result is an outlook which is less Platonic, or less realist in the medieval sense of the word. "How far it is possible to go in the direction of nominations remains, to my mind, an unsolved question, but one which, whether completely insoluble or not, can only be adequately investigated by means of mathematical logic" (p. xiv). We might point out, however, that this opinion looks rather like an encouragement to his followers, if we take into account two facts: the tendency of logicians to reduce this symbolical apparatus to a minimum, and to return more and more to linguistic explanations of their views; and the tendency of 'logical' mathematicians and of 'mathematical' logicians to consider mathematics and logic as two separate disciplines in spite of their common elements. T. G.

Trigonometry

By Prof. T. M. MacRobert and William Arthur. Part 2: Higher Trigonometry. Pp. ix+203–341+xi–xiii. 4*s*. 6*d*. Part 3: Advanced Trigonometry. Pp. viii+343–478+ix–xi. 4*s*. 6*d*. Part 4: Spherical Trigonometry. Pp. vii+479–542+ix–x. 3*s*. (London: Methuen and Co., Ltd., 1937-1938.)

THESE books are companion volumes to Part 1, published earlier and dealing with that portion of the subject usually read by first-year students in the universities and by pupils of advanced courses in schools.

Part 2 is designed to provide an introduction to analytic trigonometry and to the theory of logarithmic and exponential functions. The authors have given very lucid discussions on complex numbers, Demoivre's theorem, expansion in infinite series and hyperbolic functions. In the final chapters, the methods of the calculus have been freely used.

Part 3 deals mainly with convergence. There are three chapters, the first of which gives an elementary account of convergence; then follows a chapter on uniform convergence; whilst the final section is concerned with infinite products and with functions of a complex variable. Some interesting applications of the theory of Dirichlet's integrals to trigonometrical series are also included. An appendix is added in which there is a discussion of the length of a circular arc.

Part 4 is devoted entirely to spherical trigonometry and consists only of one chapter. Proofs of all the standard formulæ connected with spherical triangles are given, and the authors have suggested what appears to be quite a good scheme for the systematic solution of spherical triangles.

In each part numerous sets of exercises are provided at the ends of the chapters for the student's practice, and where necessary, answers are given. The four parts together form a thoroughly sound and comprehensive course in trigonometry which should be very useful to students of mathematics.

F. G. W. B

Medical Studies

A Pocket Medical Dictionary

Compiled by Lois Oakes, assisted by Dr. Thos. B. Davie. Third edition. Pp. xx+397. (Edinburgh: E. and S. Livingstone, 1938.) 3*s*. net.

THE first edition of this useful and handy little work appeared in 1933. It has now been brought up to date by the inclusion of a large number of new words and 120 fresh illustrations. A considerable amount of heterogeneous information has been appended, such as notes on infant feeding, poisons and their antidotes, methods for working out doses, eminent medical men and gas warfare protection.

Climate and Acclimatization:

Some Notes and Observations. By Sir Aldo Castellani. Second edition. Pp. x+198+4 plates. (London: John Bale, Sons and Curnow, Ltd., 1938.) 10*s*. net.

THIS excellent little book, which is based on the eminent author's prolonged experience of residence in various tropical climates, will prove of value not only to medical practitioners but also to missionaries, nurses and others who propose to take up work in the tropics. The work contains four chapters devoted respectively to introductory remarks on climate, to which the author attributes more importance than some of his immediate predecessors, such as Manson and Gorgas; the effects of climate on various systems of the body; a description of atmospheric pressure, trade winds, sun-rays, chemical rays and moon-rays; and acclimatization, including an account of the sanitary condition and health of white troops during various tropical wars, and particularly the Italo-Ethiopian War, in which the author was director-general of the medical services. A classified international bibliography is appended.

Meteorology

Hurricanes:

their Nature and History—particularly those of the West Indies and the Southern Coasts of the United States. By Ivan Ray Tannehill. Pp. x+257. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1938.) 16*s*. net.

THE early part of the book under notice gives a description of hurricanes, the tropical cyclones of the West Indies and the southern coasts of the United States, followed by a discussion of their tracks, the variations of pressure, the distribution of rainfall, the destructive effects of the high winds, and a full description of some historic hurricanes.

Nearly every aspect of the subject is treated, and well treated, and not the least interesting part of the book is the discussion of the relation of their origin to the presence of fronts. It provides a much-needed account of a subject on which general agreement has not yet been reached.

Synoptic and Aeronautical Meteorology

By Dr. H. R. Byers. Pp. ix+279. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 21*s*.

DR. BYERS discusses the subject of meteorology, and in particular the methods now known as air-mass analysis, from the point of view of the practical forecaster, and succeeds in producing a picture of modern meteorology which is at once interesting to read and easy to follow. Mathematical methods are avoided, as are the more speculative parts of the subject. Special consideration is given to the forecasting of precipitation, fog, thunderstorms, tornadoes, and other aspects of weather, the maps and charts being drawn from American sources. This is a useful addition to the library of all who are interested in weather.

Miscellany

Scientific Illustration

By John L. Ridgway. Pp. xiv+173+23 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1938.) 18*s*. net.

THE object of this book is to aid students and others engaged in the preparation of manuscripts requiring illustration, which includes the method of assembly and display of illustrations and diagrams designed for scientific publications, and the placing of the matter in a form convenient for reference. It ranges over almost every kind of illustration likely to be required by a scientific writer, including such varied subjects as geological specimens and sections, maps, photographs, processes of reproduction suitable for illustrations in colours and half-tone, the construction of block drawings, and much else. Useful hints are given on retouching specimen photographs and on the grouping of figures so as to make the most effective display.

Naturally such a number and variety of subjects cannot be dealt with in much detail, but numerous references, mostly American, are given for fuller information.

The author is scientific illustrator and artist, Californian Institute of Technology and Carnegie Institution of Washington; and was formerly chief illustrator, United States Geological Survey. The book is very well got up and printed. Every illustration and figure, of which there are many, is beautifully clear and well reproduced, in part due to the excellent paper used. Judging by the plates and figures drawn by the author himself, he must be a most accomplished artist. We can recommend this work to all interested in illustration. It contains many useful practical tips, evidently the result, as one might expect, of considerable experience in this class of work. H. L. C.

Business Man's Guide to Management

By G. E. Milward. (Sixth annual edition.) Pp. xiv+114. (London: Management Library, 1938.) 5*s*.

THE sixth annual edition of the "Business Man's Guide to Management" covers all books published up to the end of 1937. In addition to the classified lists of books, with brief descriptive notes on their contents, a subject index, a publisher index, an author index and suggested courses for reading, a numerical and page index is now included. Reference to the main divisions—general management, accounting, production, distribution, company secretary, psychology, industrial economics, public administration, and individual trades—is facilitated by use of distinctive paper for each of these divisions. The more outstanding books published in 1937 are listed separately in the preface; this enhances the value of this cumulative guide to an important and voluminous section of literature.

The Microscope: Theory and Practice

By Conrad Beck. Pp. 264. (London: R. and J. Beck, Ltd., 1938.) 7*s*. 6*d*. net.

THIS is a new edition, combining Mr. Conrad Beck's two previous books on the microscope, one elementary, the other more advanced, with the addition of much new matter, but, by judicious elimination, without increase in size. The information given is clear and lucid, and can be understood by anyone having but an elementary knowledge of optics and mathematics. The beginner will appreciate the directions given for the care of lenses and instrument, and for illumination and technique, the important subject of dark-ground illumination being dealt with at some length. Chapter iii, on apperture and resolution, gives full details on these important subjects, without a knowledge of which the microscopist cannot hope to obtain the best results, or correctly to interpret his observations. Other chapters deal with the photometry of the microscope, microscope stands and accessory apparatus, microprojection, lens testing and polarized light as applied to the microscope.

The volume is profusely illustrated and can be recommended as a relatively simple and yet a comprehensive and trustworthy text-book on the microscope and its use as an instrument of research.

Philosophy

Einführung in die mathematische Logik: und in die Methodologie der Mathematik.

Von Alfred Tarski. Pp. x+166. (Wien und Berlin: Julius Springer, 1937.) 7.50 gold marks.

THIS is a very useful introduction to mathematical logic, which does full justice to its title, in so far as it really carries the reader into the principles of mathematics interpreted mainly in terms of logical notions. Most elementary works on this subject make a mountain of a molehill by confining themselves to the exposition of its purely logical prolegomena and dismissing their application to mathematics with the excuse that they are too difficult

for lay readers. Dr. Tarski rightly thinks otherwise. After a restricted account of the leading doctrines of symbolic logic (pp. 1–97), he gives a short exposition of the idea of number, of the simple arithmetical operations, followed by a short discussion of the methodology and the axiom-system of arithmetic. This is an illuminating and sufficient introduction to the analysis of the logical foundations of elementary arithmetic. But once the purpose and technique of the method are thoroughly understood, it will be easier for the reader to tackle the more advanced works on the subject. Dr. Tarski helps him in this connexion by suggesting a number of easy examples after each chapter. Controversial questions are carefully avoided, and the technical apparatus is reduced to a minimum, though one may have wished for practice' sake more symbolic formulæ and proofs. Yet, as it is, Dr. Tarski's book, with the authority of its author, who is a leading member of the Polish school of mathematical logicians, fulfils a real want and is well worthy of an English translation. T. G.

Explanation and Reality in the Philosophy of Émile Meyerson
By Prof. Thomas R. Kelly. Pp. xii + 134. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1937.) 9*s*. net.

THE epistemological doctrines of Meyerson have gained a permanent place in contemporary philosophy. The influence of this eminent thinker radiates beyond the wide circle of his disciples, and explains the importance of authoritative expositions of his doctrines, such as the one written by Prof. Kelly. The dramatic conflict between the way followed by explanation and the way followed by reality is the source of Meyerson's system. If he began by stressing these differences, however, Meyerson was led, later, to submit that some kind of convergence and identity of structure is necessary in order that the intent of knowledge may be achieved. Prof. Kelly follows closely the development of these doctrines, and while taking a sympathetic view of them, he does not fail to point out their outstanding deficiencies. This work can serve as an introduction not only to the philosophy of Meyerson, but also to the central problems to scientific thought.

Examination of McTaggart's Philosophy
By Prof. C. D. Broad. Vol. 2, Part 1. Pp. lxxv + 514. Vol. 2, Part 2. Pp. 515–796. (Cambridge: At the University Press, 1938.) 45*s*. net.

WITH the publication of these two parts of his "Examination", the detailed exposition and criticism of "The Nature of Existence" is brought to its completion with that touch of brilliant scholarship which characterizes the works of Prof. Broad. The profound meaning of McTaggart's philosophy is thus brought to light in a much larger work: it could scarcely be otherwise, if a thorough discussion of all the details of that great system was contemplated. In comparing "The Nature of Existence" with the "Examination", one cannot help feeling as much admiration for the analytical and critical effort of the second as for the powerful synthetic composition of the first. Here we can feel two minds grappling together with the major problems of thought and existence which have been the concern of the great thinkers of all times. It is then a kind of anti-climax to see Prof. Broad write at the end of his inquiry, that he was struck by the "thinness" of McTaggart's philosophy; and that he asked himself whether all this speculative effort was worth doing at all. But perhaps it is in the very imperfection of all human attempts to solve the riddle of existence and yet in their ineluctable urge of trying to do so, that the eminent critic as well as any modest reader may find a cause for wonder at the achievements of the human intellect.

Physics

Electricity and Magnetism for Degree Students
By Sydney G. Starling. Sixth edition. Pp. vii + 630. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937). 12*s*. 6*d*. net.

THIS well-known text-book has been extensively revised, and reset in larger type. The changes which have been made include the insertion of an account of the Hall and allied effects, and the omission of the description of the magnetization of ships. The sections on atomic phenomena have been extended considerably, and now provide a good introduction to this relatively new work. The book, which covers rather more than is needed for a pass degree in physics and provides a sound framework for an honours course, remains probably the best treatise of its kind in English on experimental electricity.

Collisions of the Second Kind:
Their Role in Physics and Chemistry. By Dr. E. J. B. Willey. Pp. viii + 150 + 1 plate. (London: Edward Arnold and Co., 1937.) 10*s*. 6*d*. net.

THE molecular collisions most familiar to classical kinetic theory are those wherein the kinetic energy is conserved. The early successes of the dynamical theory of gases are due to the fact that certain atoms and simple molecules do, in fact, resemble elastic spheres under a variety of conditions. Latterly, however, an important group of phenomena has been discovered experimentally which shows that many gaseous collisions—particularly those involving electrons—occur with changes in the kinetic energy. The conditions which govern the conversion of kinetic energy into the various possible kinds of internal energy are as yet but dimly understood; and on that account alone, Dr. E. J. B. Willey's book is to be welcomed.

The subjects covered are diverse, and include the excitation of spectra, inelastic collisions at interfaces, resonance radiation and chemical reactions.

The book is the work of an enthusiast, who has himself contributed to the development of the subject. Prof. Frank is given fitting prominence throughout, and his portrait is included. We feel certain that Dr. Willey's work will be found helpful by a large number of research workers, to whom primarily it is addressed. E. A. MOELWYN-HUGHES.

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Infra-red and Raman Spectra of Crystalline Hydrochloric Acid

A KNOWLEDGE of the vibration-rotation spectra of crystalline hydrochloric acid is of considerable importance in view of the theories of Pauling[1], Fowler[1], and others on rotation in the solid state. Although several investigators have taken up this problem, the existing experimental data are confusing and even conflicting. Thus Hettner[2] has reported that in infra-red absorption a doublet band is found below the transition point (98° K.) and a single absorption maximum above it. On the other hand, Shearin[3] has reported the existence of thirteen discrete rotation lines at liquid air temperature (that is, around 85° K.) and this result has recently been quoted[4] as indicating that rotation exists below the transition point. It seemed possible that the discrepancy between those two results might be due to the fact that Shearin had the higher resolving power of a grating at his disposal. We have just completed a very careful examination of the absorption near 3·7μ of thin layers of solid hydrochloric acid at the temperature of liquid air, using a grating spectrometer at least equal to that of Shearin's in resolving power.

Our observations agree very closely with those of Hettner for this temperature. We can find no trace of the individual lines in the positions indicated by Shearin, although there are signs of some further structure in the doublet. In addition, we have examined the absorption of layers of solid DCl near 5μ at the same temperature. Here we find not two peaks but three distinct maxima with indications of more structure. The two extreme maxima appear to correspond to the maxima of the HCl doublet, since their frequencies give the same isotopic ratio. As regards the appearance of the third maximum, we might remark that we have had indications of a similar additional peak in HCl when the gas has been condensed on to a surface at a temperature above that of liquid air and afterwards cooled to liquid air temperature. The pure doublet is obtained when the hydrochloric acid is condensed immediately on a surface at liquid air temperature.

VIBRATION SPECTRA OF CRYSTALLINE HYDROCHLORIC ACID

	Observers' initials	Below transition point	Above transition point	DCl
Infra-red absorption	H.	2708(s)2747(w)	2768	—
	L.S.& W.	2704(s)2746(w)		1990(w) 1979(m) 1965(s)
Raman scattering	C.& S.		2763	
	L.S.& W.	2709(s)2759(w)		

s = strong, m = medium, w = weak in intensity.

The only observations on the Raman spectrum of solid hydrochloric acid are those of Callihan and Salant[5], who found a single broad line extending from 2,743 cm.$^{-1}$ to 2,784 cm.$^{-1}$. The centre of this line is in good agreement with the centre of the single absorption peak found by Hettner above the transition point at 100° K. Since the scattering experiments were done with the crystal only a few degrees below the melting point (presumably about 155° K.) this seems quite satisfactory. We have now succeeded in observing the Raman spectrum of hydrochloric acid at the temperature of liquid air. We find that it consists of two distinct lines, one of which, lying at 2,709 cm.$^{-1}$, is much stronger and broader than the other at 2,759 cm.$^{-1}$. The uncertainty in the determination of the Raman frequencies is unlikely to be greater than 5 cm.$^{-1}$, and of the infra-red ones, 2 cm.$^{-1}$, so there appears to be a small discrepancy between the value of the higher frequency according as it is observed in absorption or in scattering.

A full account of these experiments, which are being continued at other temperatures and on methane and germane, will appear later elsewhere.

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Aug. 27.

[1] Pauling, *Phys. Rev.*, **43**, 430 (1930); Fowler, R. H., *Proc. Roy. Soc.*, A, **149**, 1 (1935).
[2] Hettner, *Z. Phys.*, **89**, 234 (1934).
[3] Shearin, *Phys. Rev.*, **48**, 299 (1935).
[4] Bartholomé, Drikos and Eucken, *Z. phys. Chem.*, B, **39**, 371 (1938).
[5] Callihan and Salant, *J. Chem. Phys.*, **2**, 317 (1934).

Predissociation Phenomena in Spectra of some Diatomic Molecules

IN emission at low pressure, the C-band (0,0) of strontium hydride is cut off above $R(18) = 26{,}549$ cm.$^{-1}$, the upper level of which (C, $v = 0$, $J = 19$) lies 27,776 cm.$^{-1}$ above the ground-level N, $v = 0$, $J = 0$. In spite of this, Watson and co-workers found no traces of the (1, 0) band in emission at low pressure, though the levels C, $v = 1$, $J = 1$ to $J = 6$ lie only 27,620 to 27,770 cm.$^{-1}$ above this ground-level (cf. More and Cornell[1], table 1). Thus the statement of More and Cornell (p. 808) that the (1, 0) band "lies far beyond the predissociation limit at $K' = 19$ in the (0, 0) band" must be incorrect. Consequently the predissociation occurs at an energy-level at least ~ 150 cm.$^{-1}$ lower in C, $v = 1$ than in $v = 0$. Previously Herzberg[2] has found similar cases in the P_2 and N_2 molecules.

Now it is very interesting that the C state of barium hydride behaves in quite an opposite way[3]. Here in emission the (1, 1) band is clearly present, while only very faint traces can be recovered of the (0, 0) band. Apparently we have to deal with two different cases of predissociation: in the first case (P_2, N_2, CO, SrH . . .) the cut-off appears at lower energy and of course at lower J-value, in a higher vibrational level than in a lower; in the second case (BaH), the cut-off occurs at lower energy in a lower vibrational level than in a higher.

According to Herzberg, the first case of predissociation here mentioned may be explained as an effect of potential barriers at large nuclear distances in the intersecting potential curve (Herzberg, case b). But if the "crossing over" occurs above the predissociation limit (Herzberg, case c), the transitions between the predissociated and intersecting potential curves take a greater role in the predissociation phenomena than in the first case mentioned. According to the Frank-Condon principle, the two cases of predissociation then may be explained as an effect of overlapping wave functions. In $v = 0$ of the predissociated state, the wave function has one maximum between the turning points. In the higher vibrational levels the maxima at the turning points are larger than those between the points. Further, the difference $r_{max.} - r_{min.}$ between the turning points is larger at the same energy in a higher vibrational level with a lower J value, than in a lower vibrational

level with higher J value. If now the intersection takes place at the outer or inner part of the predissociated curve, then, as a result of both circumstances just mentioned, the $U(r) + T(r, J)$ curves belonging to low J values probably will be more influenced than those which belong to higher J values (first case). On the other hand, if the intersecting point lies near r_e and the intersecting curve is then mainly symmetrical between the inner and outer part of the predissociated curve, all the rotational levels in $v = 0$ may be more influenced by the intersecting curves than those of $v = 1$ (second case, BaH, cf. Grundström, diss. Fig. 31).

Thus the position of the intersecting point in relation to the equilibrium distance r_e of the predissociated state seems to be significant for the predissociation phenomena.

A fuller account will appear in the *Zeitschrift für Physik*.

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July 30.

[1] More, K. R., and Cornell, S. D., *Phys. Rev.*, **53**, 806 (1938).
[2] Herzberg, G., *Ann. Phys.*, **15**, 677 (1932). Büttenbender, G., and Herzberg, G., *Ann. Phys.*, **21**, 577 (1934).
[3] Grundström, B., *Z. Phys.*, **99**, 595 (1936); Dissertation, Stockholm, 1936. Funke, G. W., and Grundström, B., *Z. Phys.*, **100**, 293 (1936).

Atomic Lines in the Auroral Spectrum

IN a letter in NATURE of June 25, R. Bernard has published results of auroral spectrograms obtained at the Tromsö Observatory. In that connexion, I should like to direct attention to the fact that all the experimental results he derives from his spectrograms are well known and have been described by me and my collaborators.

The presence in the auroral spectrum of bands of the ε-system, discovered and interpreted by me as due to the forbidden transition $A(^3\Sigma) - X(^1\Sigma)$ of N_2, was found in 1933[1]. About fifteen vibrational bands of the ε-system (now commonly called Vegard-Kaplan bands) including those mentioned by Bernard, were observed by me in the auroral spectrum[2].

It is also well known that spectra of diffuse auroras and auroras at great altitudes[3] in many ways differ from those of the distinct forms at low altitudes. They differ, for example, in the appearance of a large number of weak lines, many of which are not to be found on spectrograms from distinct forms at low altitudes (cf. ref. 1, Pl. 1, Fig. 2).

The line 3470 was obtained by me with a large quartz spectrograph and measured so long ago as 1922[4,5], and on a large number of spectrograms during the following years.

From our spectrograms of fairly large dispersion we get the mean wave-length 3469·4. In accordance with the observations of Bernard, we find that the intensity of the line 3470 relative to bands of the $2P.G.$ may differ considerably for different spectrograms (cf. ref. 5, Table XI and ref. 1, Table X). We have regarded the line as the head of a band $2P.G.$ (3–4) (3469), while Bernard has referred it to the line 3470 recently observed by Kaplan[6] in a nitrogen discharge tube, thought to be due to the forbidden transition from the metastable (^2P) state to the normal (^4S)-state of the neutral nitrogen atom.

Our interpretation is supported by the close agreement in wave-length and by the fact that a number of other bands of the series $2P.G.$ (3–n) appears in the auroral spectrum. The great variation in intensity relative to other bands of the $2P.G.$, however, would be accounted for if we suppose that an atomic line (3470) with varying intensity also appears. Also on my spectrograms (cf. plates, refs. 1 and 2) the line appears sharp, but for small photographic densities the head of a band may also appear quite distinct.

Although the present observational data do not settle the question as to the appearance of the NI-line, the interpretation suggested by Bernard is of particular interest in relation to certain results obtained by me and my collaborators.

Already from the spectrograms obtained in 1922–24 we measured a number of weak lines which were referred to atoms of oxygen and nitrogen in the neutral or ionized state. Until recently, these lines had only been measured from spectrograms with small dispersion, so the identification was uncertain. During the last two years, with E. Tönsberg I obtained two of these lines (4415·1 and 4368·2) with a spectrograph of large dispersion, and was able to identify them as O-lines. Their intensity follows the sunspot frequency, which shows that the concentration of oxygen atoms fluctuates in a similar way to the solar activity.

Since these results were obtained, I have made a careful study in order to see which atomic lines might possibly appear in the auroral spectrum.

Up to the present, I have found that about twenty auroral lines may be referred to atoms of oxygen and nitrogen in the neutral or ionized state. Within the limit of error, ten of these lines coincide with nebular lines.

In addition to the well-known green and red OI lines, we find that the following forbidden lines from the atomic ground states may probably be present in the auroral luminescence. The OII doublet ($^2D^0_{2\frac{1}{2}} - {}^4S_{1\frac{1}{2}}$) ($\lambda$ = 3728·6), the OIII lines ($^1S_0 - {}^1D_2$) (4362) and ($^1D_2 - {}^3P_2$) (5003), the NII lines ($^1S_0 - {}^1D_2$) (5751), ($^1D_2 - {}^3P_1$) (6526) and ($^1D_2 - {}^3P_2$) (6543) and finally, the NI-line ($^2P_{1,2} - {}^4S^0_2$) (3469·4) as suggested by Bernard.

These results indicate that nitrogen and oxygen atoms in different states of ionization are present in the auroral region and that the physical conditions in this region are such that lines corresponding to forbidden transitions from the metastable ground states of OI, OII, OIII *and* NI *and* NII *appear in the auroral spectrum.*

In addition, some auroral lines are observed which correspond to transitions from higher levels of OI, OII, NI and NII.

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Aug. 25.

[1] Vegard, L., *Geof. Publ.*, **10**, No. 4 (1933).
[2] Vegard, L., *Z. Phys.*, **106**, 108–131 (1937).
[3] Vegard, L., *Phil. Mag.*, **46**, 580 (1923).
[4] Vegard, L., *Phil. Mag.*, **46**, 193 (1923).
[5] Vegard, L., *Geof. Publ.*, **9**, No. 11 (1932).
[6] Kaplan, J., NATURE, **141**, 1139 (1938).

Bode's Law and the Systems of the Planets and Satellites

IN my letter in NATURE of February 5 (**141**, 245), I pointed out that a slight alteration in the usual form in which Bode's Law is stated leads to some interesting results in Saturn's satellite system. As the amended method of stating the law assists in certain conjectures regarding the satellites of Jupiter

also, it may be desirable to repeat a few points in my previous letter. If we take the distance of Mercury from each planet in turn (not the distance of the sun, as is usually done), it will be found that these distances are approximately in geometrical progression. The figures are as follows:

Mean distance between the orbits of	Astronomical units	Computed distance assuming the geometrical ratio 2 Astronomical units
Mercury and Venus	0·33	0·33
,, Earth	0·61	0·66
,, Mars	1·13	1·32
,, Asteroids	—	—
,, Jupiter	4·87	5·28
,, Saturn	9·21	10·56
,, Uranus	18·85	21·12
,, Neptune	29·74	42·24
,, Pluto	39·17	84·48

As is well known, Bode's Law breaks down in the case of Neptune and Pluto, and the figures are not even approximate for these planets. If the satellites of Saturn are dealt with in the same manner, taking the distance between Mimas and Enceladus as the unit, the actual and computed distances are as shown in the table below, the geometrical ratio 2 being assumed:

Mean distance between the orbits of	Astronomical units	Computed distance assuming the geometrical ratio 2
Mimas and Enceladus	1·00	1
,, Tethys	2·13	2
,, Dione	3·74	4
,, Rhea	6·69	8
,, Titan	20·29	16
,, Hyperion	25·37	32
,, Iapetus	66·07	64
,, Missing satellite		128
,, Phœbe	250·00	256

There appears to be a large discrepancy in the cases of Titan and Hyperion, but it was pointed out in my previous letter that, as these satellites have fairly large eccentricities, there may be certain difficulties in measuring their distances from their primaries with great accuracy. It was also suggested that there is a missing satellite between Iapetus and Phœbe.

The Jovian system presents certain interesting features which can be dealt with on the same basis—taking the distance from the nearest satellite, V, to satellite I, as the unit. The results are as shown below, the ninth satellite being omitted for reasons which will appear later:

Mean distance between the orbits of	Astronomical units	Computed distance assuming the geometrical ratio 2
V and I	1·00	1
,, II	2·03	2
,, III	3·69	4
,, IV	7·05	8
,, Missing satellite		16
,, VI	46·74	32
,, VII	47·93	64
,, VIII	96·71	128

There is a very definite gap between IV and VI and some months ago, while discussing the matter with my astronomical friends, I predicted that there was a missing satellite in this region. It is possible that this prediction will be fulfilled if one of the two new satellites of Jupiter, recently discovered by Dr. S. B. Nicholson, is found to be between satellites IV and VI. If its motion is direct, as it almost certainly would be in this region, I am of opinion that this completes the number of direct moving satellites of the Jovian system.

The retrograde satellites have most probably had an origin different from that of the direct satellites. If we consider the system of Uranus, it will be seen that the geometrical progression law is inapplicable, but there is a close approximation to the arithmetical progression rule. Thus, if the distance between Ariel, the inner satellite, and Umbriel, the next in order of distance, be taken as the unit, the distances of Titania and Oberon from Ariel are approximately 3 and 5 units. Presumably if another satellite of Uranus is ever discovered it will be 7 units from Ariel, or about 460,000 miles from its primary. While this rule is purely empirical and only very approximate, it may, nevertheless, be used as a criterion with regard to the retrograde satellites of Jupiter. The distance between VIII and IX, the two retrograde satellites as known up to the present, is about 400,000 miles, and on the analogy of Uranus, the next retrograde satellite should be 800,000 miles from IX. Hence, either satellites X or XI, newly discovered, should be at a mean distance from Jupiter of nearly 16 million miles. How far the above figures will conform to those which will be computed when further observations have been made of the two new satellites remains to be seen. If it is found that they both lie outside IX, there is still a missing satellite between IV and VI.

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Composition of the Earth at a Depth of 500–700 km.

Price and Lahiri[1] announce interesting results of their study of the electrical conductivity, κ, of the earth from terrestrial magnetic variations. They confirm the finding of Chapman and Price that there is a considerable increase in κ with increasing depth beyond 150 km. below the earth's surface, and further, express the view that the really important increase in κ occurs at a depth of about 700 km.; and they accordingly suggest a change in the composition of the earth in the vicinity of this depth. This result is specially interesting in view of recent progress in other branches of geophysics, and the purpose of this note is to direct attention to the extent of agreement indicated.

Seismological evidence has, of course, for some time made it clear that the major discontinuity within the earth occurs at the boundary of the dense central core, 2,900 km. below the surface. But more recently the work of Byerly[2], Jeffreys and Bullen[3] and Lehmann[4] on seismic waves has indicated a further change in elastic properties at a much smaller depth. On the assumption of a sudden change, Jeffreys[5] placed the corresponding depth at 474 ± 20 km. If the change is gradual, it may well be incomplete until a depth approaching 700 km. is reached. The corresponding main alteration in electrical conductivity might, on account of the existence of impurities in this case, not occur until the change was nearly complete. This would agree very well with the result of Price and Lahiri; in any event it is significant that terrestrial magnetism and seismology both indicate changes at several hundred kilometres below the earth's surface.

Another interesting point is that the value 700 km. gives the limit of the focal depth of any recorded earthquake. As pointed out by Gutenberg and Richter[6], "this result is all the more striking in view

of the fact that some of the deepest shocks are among the largest recorded".

Further evidence arises from a study of the density variation within the earth. I have shown[7] that unless there is a change of material at a depth of the order of several hundred kilometres, the deduced moment of inertia of the central core would involve a most improbable distribution of matter. Jeffreys[8] put forward the suggestion that the corresponding density jump found by me might be associated with a high-pressure modification of olivine. Bernal[9], arguing by analogy from known properties of magnesium germanate, pointed out that such a modification might take the form of a complete change in the crystal type of olivine to a cubic form. The results of Price and Lahiri indicate a change in the value of $\varkappa$ from about 10^{-13} to at least 10^{-11} electromagnetic units. It does not seem unreasonable to suppose that this figure may fit the postulated cubic form of olivine at the temperature and pressure reached.

It appears thus that a number of distinct lines of evidence are in good accord in suggesting a change in properties at a depth of order 500–700 km. below the earth's surface.

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July 22.

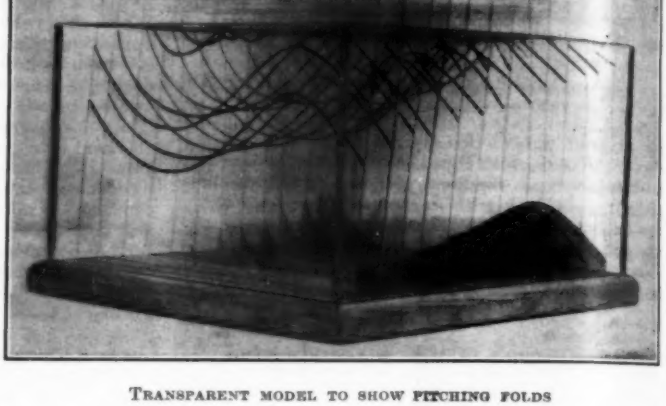
[1] Price and Lahiri, *Proc. Roy. Soc.*, A. **165**, S.55 (1938).
[2] Byerly, *Bull. Seismol. Soc. Amer.*, **16**, 209 (1926).
[3] Jeffreys and Bullen, NATURE, **131**, 97 (1933); *Bur. Cent. Séism. Trav. Scient.*, 11 (1935).
[4] Lehmann, *Geod. Inst., Copenhagen*, 5 (1934).
[5] Jeffreys, *Mon. Not. Roy. Astro. Soc., Geophys. Suppl.*, **4**, 57 (1937).
[6] Gutenberg and Richter, *Bull. Geol. Soc. Amer.*, **49**, 285 (1937).
[7] Bullen, *Mon. Not. Roy. Astro. Soc., Geophys. Suppl.*, **3**, 395 (1936) *Trans. Roy. Soc. N.Z.*, **67**, 121 (1937).
[8] Bernal, *Observatory*, **59**, 268 (1936).

Transparent Models to Illustrate Geological Structures

LARGE transparent models to show the structures of particular areas have been used for some years. So far as I am aware, they are less common in Britain than on the Continent; for example, at Lille, large models of this type have been made to show the structure of French coalfields. These models have been built up by drawing numerous accurate sections to scale, each on a separate glass sheet, and arranging these vertically at proper intervals.

Such models are invaluable to indicate underground structures to those not familiar with geological maps and sections, and they are also helpful as a check on suggested interpretations of complicated areas. Recently similar but smaller models of much simpler construction have been made. As they appear to be useful in the teaching of elementary geology and are quite inexpensive, a description may be useful to others. Similar models may also be employed for demonstrating other structural relations.

The model illustrated consists of a glass box, 6 in. × 7 in. × 3½ in., formed by four glass sheets fastened with 'Seccotine' and fitted into slots in a wooden base. Over the top is a sheet of 'Cellophane' fastened along the edges by 'Durofix'. This upper sheet, on which the geological map may be drawn, is cut by thirteen narrow slits, each vertically above a V-shaped groove in the wooden base. Thirteen sheets of celluloid with successive sections across the structure represented are thus kept vertically in their positions, and can readily be taken out to demonstrate the section along any line. Viewed from the side, a model of this size is sufficiently transparent for the whole structure to be seen in three dimensions; about a dozen sheets of celluloid seems to be the maximum number which can suitably be employed, but this depends on the amount of detail to be shown.



TRANSPARENT MODEL TO SHOW PITCHING FOLDS

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Sept. 8.

Antiquity of the Modern Type of Man

MR. MARSTON'S discovery of parts of a human skull deep in the gravel of the 100-ft. terrace of the Lower Thames at Swanscombe is of great importance and significance. Thanks to the careful and scientific manner in which this discovery was treated by him, there can remain no doubt that these human bones were indeed *in situ* in the gravel and formed an integral part of it.

The Swanscombe skull, according to the expert anatomists who have studied it, would appear to be of the modern type, while on archæological and geological grounds, the specimen is to be referred to the Acheulean period. Thus, it now seems established that, as certain students of ancient humanity have held for many years, the primitive Neanderthal-Mousterian man was preceded in time by people closely akin in their bodily form to ourselves. The discovery of the Swanscombe skull therefore once more opens up, and in a decisive manner, the question of the antiquity of the modern type of man. Mr. Marston's discovery is, however, not the only example of human bones of this general type claimed to have been found in Acheulean and earlier deposits. But it has been the custom to regard it as necessary that any human bones claimed as of great antiquity must, in order to be accepted, and in addition to the

geological data supporting this claim, exhibit definite primitive and simian characteristics.

The reason for this would appear to be the belief that man is evolved from an anthropoid stock and, in consequence, any really ancient human bones would show evidence of this ancestry. Various fossil remains of man do, of course, exhibit such characteristics, but there are others which do not, and the question arises as to whether *Homo sapiens* has evolved to his present state via the anthropoids. Upon this important matter I am not entitled to express an opinion, but from my archæological researches, I am compelled to believe that intelligent beings—shall we call them—were in existence certainly a long way back in Pliocene time, and probably in that of the Upper Miocene.

As things stand at present, however, I am confronted by the anatomists who tell me that no known anthropoid ape was sufficiently evolved at such epochs to make it possible for any flint-flaking being to have been in existence, and the *impasse* is complete. I have therefore read with great interest a remarkable article by Prof. H. H. Woollard, F.R.S., in the current number of *Science Progress*. In this article, Prof. Woollard suggests that man arose from the primitive primate stem in very remote times, and long prior to the branching off of the anthropoids. He states: "If man has avoided many of the anthropoid specialisations it is logical to expect that he might retain many of the early primitive characters which the great apes have modified or lost". He then, having enumerated the various anatomical features which modern man possesses, and shown that these are derived from the pre-anthropoid primate stem, continues: "Those who have these characters could not be derived from those who have lost them. A recrudescence of them by a subsequent mutation seems incredible".

Now it seems to me that these are very formidable arguments, not lightly to be put aside, and I should much like to know what other anatomists have got to say about them. If they are correct, then the great antiquity of the modern type of man, and of intelligent beings capable of implement making, becomes increasingly probable.

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Sept. 18.

Prof. Buckland and Oxford

THE verses which follow are printed by permission of Sir Edmund Phipps, K.C.B., who found them among the papers of his great-grandfather William Foskett of Bath (1763–1843), who was accustomed to preserve current songs, verses and anecdotes, communicated to him in various handwritings.

William Buckland (1784–1856) was one of the founders of scientific geology. He began to lecture at Oxford in 1813, and a special readership in geology was founded for him in 1819. He was elected fellow of the Royal Society in 1818, president of the Geological Society of London in 1824 and 1840, president of the British Association at Oxford in 1832, and Dean of Westminster in 1845. His best-known work, "Reliquiae Diluvianae", was published in 1823; his Bridgewater Treatise on "Geology and Mineralogy" in 1836.

JOHN L. MYRES.

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AN INTENDED EPITAPH ON P[ROFESSOR] BUCKLAND AT OXFORD

Mourn, Ammonites, mourn, o'er his funeral urn,
Whose neck ye must grace no more.
Gniss, Granite, and Slate, he settled your date,
And his, ye must now deplore.

Weep, caverns, weep, with filtering drip,
Your recesses he'll cease to explore,
For mineral veins and organic remains
No stratum again will he bore.

Oh, his wit shone like chrystal! his knowledge pro-
From Granite and Gravel descended, [found
No trap could deceive him, no slip c^{d}-confound
Nor specimen true or pretended.—
He knew the birth place of each pebble so round,
And how far its tour had extended.—

Though eloquence roll'd, like the deluge retiring
In which many carcases floated,
To a subject obscure he gave charms so inspiring
Young and old on geology doted.
He stood like an out-lier, his hearers admiring
In pencil each anecdote noted.

Where shall we our great Professor *inter*
That in peace may rest his bones?
If we hew him a rocky sepulchre
He'll rise to break the stones
And examine each stratum that lies around,
For he's quite in his element under ground.—

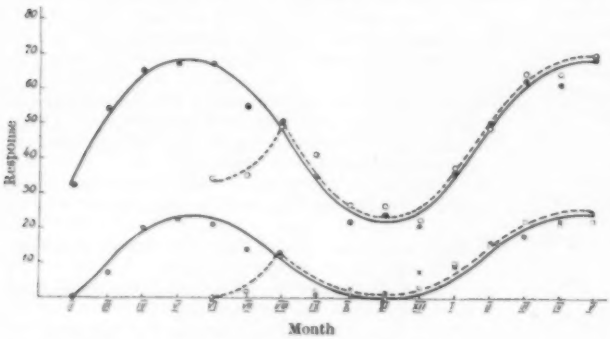
If with mattock and spade his body we lay
In the common alluvial soil
He'll start and snatch those tools away
Of his own geological toil.
In a stratum so young the Professor disclaims
That imbedded sh^{d} lie his organic remains.

Then exposed to the drip of some case-hardening
His carcase let Stalactite cover, [spring
And to Oxford the petrified Sage let us bring
When he is incrusted all over.
There with mammoths and crocodiles high on a shelf
Let him stand as a monument raised to himself.

Annual Cycle of Responsivity of Castrated Albino Mice to Œstrone Injection

LAQUEUR, at the sixteenth International Congress of Physiologists held at Zurich in August last, reported that the response given by capons to a given dose of androgen varies according to the time of year, being lowest in winter and highest in summer. An analogous rhythm in the responsivity of castrated albino mice to monthly injections of 1 I.U. of œstrone has been found to exist, the response being more than three times as great in May as in November. The upper full-line curve in the accompanying figure represents the response given according to the State Hygiene Institute's method of evaluating vaginal smear tests in a group of 60 mice. In this method (not yet published), points are awarded to each smear (cornified epithelial cells only 5, sporadic nucleated cells 4, cornified and nucleated cells in approximately equal number 3, sporadic cornified cells 2, nucleated cells only 1, and absence of epithelial cells 0 points); maximum response in a group of 20 mice is thus 100 points. The lower curve represents

the percentage of mice developing full œstrus after each injection. A second group of mice was castrated in May 1937 and injections were commenced in June. It will be seen (broken line curves) that the responsiveness attains that of the former group (castrated in January 1937) in August, and that the curves thereafter closely follow the earlier ones.



Certain important conclusions may be drawn from our results. First, it may be said that the results of work on the œstrogen content of biological material, and based on vaginal smear methods not involving comparison with standard preparations, are highly inaccurate. Secondly, the existence of an extraneous factor modifying responsivity to œstrogens is indicated. Thirdly, should a similar rhythm exist in the human, the desirability arises of varying the dosage of œstrogens in replacement therapy, according to the season. Finally, in animals exhibiting seasonal sexual activity, variations in this activity may be due not necessarily to increased hormone production, but also to increase in responsivity.

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Decarboxylation of Aspartic and Glutamic Acids

ACCORDING to our earlier reports[1], the legume bacteria split off quantitatively one of the carboxyl groups from *l*-aspartic acid forming β-alanine,

$$HO_2C.CH_2.CH(NH_2).CO_2H \rightarrow HO_2C.CH_2.CH_2NH_2 + CO_2.$$

The reaction was at first accomplished only with living bacteria. We have now succeeded in observing it also *in the presence of toluene* with the same bacteria. The bacterial suspension, which had been kept 24 hours under toluene, split off carbon dioxide forming β-alanine in an aspartic acid solution (*p*H 7) in the presence of toluene.

In addition to aspartic acid, the legume bacteria split off the carboxyl group also from the *l*-glutamic acid forming γ-amino butyric acid,

$$HO_2C.CH_2.CH_2.CH(NH_2).CO_2H \rightarrow HO_2C.CH_2.CH_2.CH_2NH_2 + CO_2.$$

This compound has been isolated as the gold salt. The reaction is quantitative like that with aspartic acid. The *p*H optimum is likewise the same (*p*H 7). The rate of the decomposition of glutamic acid is somewhat higher than that of aspartic acid. Legume bacteria do not decarboxylate any other amino acids except aspartic and glutamic acids. Thus it may be assumed that the same enzyme is acting in the decarboxylation of both these amino acids. Since, however, Okunuki[2] has recently succeeded in decarboxylating glutamic acid with plant material, for example, dried beet powder, while aspartic acid does not react at all, it is likely that the legume bacteria contain two different amino acid decarboxylases, one decarboxylating glutamic acid (glutamic decarboxylase) and the other aspartic acid (aspartic decarboxylase).

As shown earlier by us[1,3], the coil bacteria split off the carboxyl group from lysine forming cadaverine almost quantitatively. We suggest the name lysine decarboxylase for this enzyme.

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T. LAINE.

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Aug. 31.

[1] Virtanen and Laine, *Suomen Kemistilehti*, B, **10**, 2 (1937). *Enzymologia*, **3**, 266 (1937).
[2] Okunuki, *Bot. Mag.* (*Tokyo*), **51**, 270 (1937).
[3] Virtanen and Laine, *Suomen Kemistilehti*, B, **9**, 17 (1936).

Segmental Interchange Lines in *Pisum sativum*

IN a former communication[1], a list was given of seven lines of *Pisum sativum* with different arrangements of their chromosome segments. Four new types (structural types 8–11) have since been tested. The chromosome relationships now recognized are summarized in the following table.

Structural type				Chromosomes interchanged
		1	The normal or standard type (1, 2, 3, 4, 5, 6, 7)	—
,,	,,	2	Hammarlund's *K* line	1 and 2
,,	,,	3	The Thibet interchanged line ..	1 and 3
,,	,,	4	Extra Rapid	3 and 5
,,	,,	5	An interchanged type from Miss de Winton's material ..	4 and 5
,,	,,	6	An interchanged type from Prof. Winge	1 and 4
,,	,,	7	The doubly-interchanged type from Structural type 2 × Str. type 3	2 with 1 and 3
,,	,,	8	M_{11}, a new type originating at Merton	3 and 4
,,	,,	9	E.Gt.R., a new type originating at Merton in Early Giant Rogue stock	1 and 2
,,	,,	10	The *G* line from Dr. E. Nilsson	6 and 7
,,	,,	11	The *F* line from Dr. E. Nilsson	5 and 6

These interchanges have all been found in untreated material. Each of the seven chromosomes has been found to be involved in one or more interchanges.

The crosses structural type 1 × structural type 2, structural type 1 × structural type 9 and structural type 2 × structural type 9 all have a ring of four chromosomes at meiosis. It is therefore clear that, although the chromosomes concerned in the two interchange types 2 and 9 are the same, a different combination of segments is involved. Moreover, since neither of these lines has a dicentric (double

attachment) chromosome, the break must have taken place on different sides of the centromere, in one, and one only, of the chromosomes concerned in the two interchanges.

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[1] Sansome, E., Nature, **130**, 113 (1937).

Dosage and Response in Vitamin E Treatment

For the last two years in this laboratory we have been working to establish the relationship between dosage and response to vitamin E treatment. Some discussion of the experimental conditions that we consider necessary for this work has already been published[1,2]. We have now completed a detailed account, which we hope to publish elsewhere, of the construction of a response-curve; this is of the sigmoid type, owing to the quantal nature of the response in question.

With the kind collaboration of Dr. J. O. Irwin, it has been possible to calculate the equation to the regression line that relates the probits of the responses to the logarithm of the doses. Between 200 and 250 animals were used in the construction of this curve, and the error of the 'mean fertility dose' calculated from this curve was found to be, for $P = 0{\cdot}99$, 71–141 per cent, and for $P = 0{\cdot}95$, 77–129 per cent. Naturally, in individual tests, where 10, or at most 20, animals are used, the error will be very much higher. In one instance examined, where 10 animals formed the test group, the limits of error were, for $P = 0{\cdot}99$, 48–209 per cent.

In spite of the large inherent error, which appears to be unavoidable in this type of test, it is thought that the relationship established between dosage and response may be of use to others besides ourselves. It makes possible calculation of the mean fertility dose of a source of vitamin E when the percentage fertility from a known dose has been established; the nearer the found fertility is to 50 per cent fertility, the greater will be the accuracy of the value assigned to the mean fertility dose.

We find that, if D_M and D_T are the mean fertility and the test doses respectively, and if y_T is the probit of the percentage fertility found, then

$$\log D_M = \log D_T - 0{\cdot}35y_T + 1{\cdot}74.$$

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Sept. 23.

[1] Bacharach, A. L., Allchorne, E., and Glynn, H. E., *Biochem. J.*, **31**, 2287 (1937).
[2] Bacharach, A. L., and Allchorne, E., *Biochem. J.*, **32**, 1298 (1938).

Points from Foregoing Letters

Further observations on the flow of liquid helium II are reported by Dr. J. F. Allen and A. D. Misener, showing that the velocity increases very rapidly between 2·177° and 1·15° K., and becomes independent of pressure as the area of the capillary is reduced. In no case was a purely linear flow observed, and the correction due to surface flow was found to be small.

Dr. D. H. Menzel states that the usual assumption that an appreciable intensity of the forbidden spectrum lines only occurs at high electron density is not valid. From mathematical considerations he deduces that the opposite is the case, and considers that the predominance of the forbidden lines in nebular spectra is attributable not to the effect of collisions in de-exciting an atom before it has a chance to radiate, but to the weakness of the permitted lines.

The absorption spectra, at liquid air temperatures, of a thin layer of solid hydrochloric acid in the infra-red region near 3·7μ and of the heavy variety, DCl, near 5μ, have been determined by E. Lee, Dr. G. B. B. M. Sutherland and C. K. Wu. The authors find that the Raman spectrum of hydrochloric acid at the same temperature consists of two lines at 2,709 and 2,759 cm.$^{-1}$.

The difference in the band spectrum of barium hydride, as compared with strontium hydride and other diatomic molecules, is discussed by Dr. B. Grundström, who points out that two different types of predissociation are involved.

Following upon R. Bernard's referring the auroral line 3470 to a forbidden transition of the neutral nitrogen atom, Prof. L. Vegard, after a further study of the auroral spectra, considers that a number of other lines may be due to nitrogen and oxygen atoms in different states of ionization in the auroral region.

By applying to Jupiter's satellites the slightly modified Bode's law, which was found to fit roughly in the case of those of Saturn, J. Miller infers that there is a missing satellite (after satellite No. 4) and suggests that one of the two bodies recently discovered by Dr. S. B. Nicholson may possibly fill that gap.

Dr. K. E. Bullen directs attention to the lines of evidence from different branches of geophysics, which all suggest that a change in the properties of the earth occurs at a depth of order 500–700 km. below the surface.

In view of the discovery of the Swanscombe skull, of Acheulean period, but having characteristics of modern man, J. Reid Moir inquires whether it is not justifiable to assume, as Prof. Woollard does, that man was derived from an earlier stock, prior to the branching off of the anthropoids.

A seasonal rhythm in the response of castrated albino mice to injections of œstrone, similar to that reported in the case of the action of androgen upon capons, is described by Dr. J. Duszyńska. The response is greater in spring than in autumn, being more than three times as great in May as in November. This variation affects the conclusions arrived at from biological assays by the vaginal smear methods, unless carried out in comparison with standard preparations.

A. L. Bacharach has studied the relationship of response to dosage of vitamin E. An equation is given showing the relation between the response to an experimental dose and the dose that will give 50 per cent fertility in a group of animals.

Research Items

Iron Age Poland

FOR four years, excavation has been proceeding on a six-acre iron age village site at Biskupin in the northern part of Great Poland under the Poznan University Archæological Expedition. This is a prehistoric stronghold which was built on a peninsula jutting into the lake of Biskupin on the surface of a former peat-bog, in the Early Iron Age between 700 B.C. and 400 B.C. An account of the results is given by Prof. J. Kostrewski in *Antiquity* of September. During the Bronze and Early Iron Ages a great part of Poland, as well as eastern Germany, was inhabited by an agricultural people known as the Urnfield people of Lusatian type, who are considered by nearly all Polish prehistorians to be ancient Slavonic. Under pressure from a people, probably of Baltic stock, they took refuge in forts of wood and earth in inaccessible spots, a number of which have been identified. Nothing but the necessity of defence could have induced the inhabitants of Biskupin to occupy so unhealthy and unsuitable a site for building. The peninsula, surrounded on three sides by the lake and cut off on the land side by marshy ground, was in addition strongly fortified by a wooden rampart filled with beaten earth carried round the whole site. This rampart was built three times, each time nearer the centre of the peninsula. The rebuilding was evidently due to a rising in the water-level. The area was occupied by a populous settlement, composed of 80–100 huts, built on layers of birch fascines, resting on the surface of the peat-bog. The ground-plan was laid out in a masterly fashion, which would do credit to a modern town-planner. So far, eight perfectly parallel roads or lanes have been laid bare, in which rows of wooden huts stand side by side, even touching. The lanes are corduroy of oak logs. The huts, about ten yards square, contain two rooms. The floors are of beams covered with clay, and stone hearths were also covered with clay. The antiquities recovered afford evidence of the continuity of Lusatian and later Slav culture.

Artificial Incubation of Game Birds

THE demand for game birds in the United States has led to the development by private and commercial breeders of methods of producing game by incubator-brooder methods. Artificial incubation has given rise to many difficulties, and in an effort to solve these, Cornell University Agricultural Experiment Station has conducted, under the direction of Alexis L. Romanoff, a series of experiments over a period of five years. The results of the first two years work dealing with temperature and humidity requirements of pheasant and quail eggs were published some time ago, and now the results of the final three years appears from the Station as *Bull.* 687 (March 1938). It concerns the effect of air movement and the role of the interrelation of temperature, air-movement and humidity, in the incubation of pheasant and quail eggs. Although each species has its own needs there is a definite relationship between these three factors, so that a proper adjustment of temperature and humidity must be made according to the rate of air-movement. Such adjustment permits the more extensive use of agitated-air-type incubators for greater efficiency in hatching. Pheasants' eggs incubated for the first 20 days in such an incubator may thereafter be hatched most successfully in a still-air incubator under proper conditions. But quail's eggs may be incubated and hatched most successfully in an agitated-air incubator provided that with increase in air movement there is a corresponding increase in both temperature and relative humidity.

An Indian Mosquito-destroying Fish

THERE has been some doubt about the value of *Panchax panchax* as a mosquito-destroyer, since F. Sen found from an examination of the food under natural conditions that the fish showed no selective food-habit. It appeared to swallow any small moving object, animal or vegetable, which came within its range of vision; and the result was that only about 10 per cent of the fish examined contained mosquito larvæ. Dr. S. L. Hora and K. K. Nair point out, however, that the waters in which the fish lives are as a rule free from mosquito larvæ, and therefore offer no assistance in deciding its mosquito-control value. They have therefore tested this value by two sets of experiments: by introducing the fish into pits in which mosquito larvæ were living and observing their food from day to day, and by providing the fish with a mixed food-supply in laboratory tanks and studying the food consumed, at intervals of 30 minutes (*Proc. Nat. Inst. Sci. India*, **4**, 245; 1938). In the first case, the observations showed that *Panchax* "preferred" mosquito larvæ, and only when they were absent or scarce did it turn to other insects, mostly ants. Normally vegetation does not form any part of the regular diet. In the second experiment, the fish also seemed to select the mosquito larvæ from amongst a miscellaneous diet. But these experiments show the same fallacy as Sen's did; until we know the relative proportions of different sorts of food in the pools and tanks *before the experiment has begun*, we cannot decide from food eaten whether there has been selectivity or simply non-selective swallowing of the food present.

Boron Treatment of *Citrus*

DEFICIENCY of boron has been shown to be the cause of a widespread disease of *Citrus* trees in Southern Rhodesia. The disease, known as 'hard fruit', is associated with spotting of the leaves, thick fruit rind, low juice content, absence of seeds, gumming and discoloration. A. A. Morris (*J. Pom. and Hort. Sci.*, **16**, 167; 1938), analysing 21 random leaf samples, has shown that varying boron status is correlated with varying severity of 'hard fruit' incidence. Applications of powdered borax to the soil at rates of 100–500 gm. per tree resulted in rapid increases in the boron content of the leaves, and boron accumulated in the leaves with increasing age. Leaves and fruit from 'hard fruit' trees were found to be low in boron. With the possible exception of nitrogen, it was shown that the intake of the more common nutrient elements by the young citrus

fruit does not appear to be influenced by boron treatment. On the other hand, sugars and pectins were lower in boron-deficient fruits than in fruits from trees under relatively low boron treatment. High boron treatment, however, seems to retard rather than assist the translocation of sugars to the fruit. A comparison of treated and control trees shows that severe losses of fruit are occasioned by deficiency of boron, not only during the growing season but also afterwards in the pack-house. In a particular area, the number of fruits from treated trees was 10,411, whereas the controls yielded only 4,627. The disease, which occurs in areas where the soil is very shallow and subject to marked erosion, is now being controlled on a commercial scale by the application of borax.

Gas Possibilities in New York State

The discovery in 1930 of the Wayne-Dundee gas field in Steuben, Yates and Schuyler Counties, New York, and the more recent discovery of large quantities of gas in the Oriskany sandstone at Greenwood, Steuben County, have awakened widespread interest in the search for other similarly favourable structures in the neighbourhood. In 1934 and 1935, an allocation of funds was made by the United States Public Works Administration to enable a survey to be made, and since that date the United States Geological Survey has financed exploratory work. W. H. Bradley organized the survey, and he has since, with the help of J. F. Pepper, recorded the results obtained in a detailed bulletin (*U.S. Geol. Surv.*, 899-A). The area covered by the report includes more than 3,000 square miles of Steuben and Yates Counties, southwest New York, and parts of the six adjacent counties. The main purpose of the survey was to determine the regional structure with the view of correlating it with sub-surface structure. How far this purpose was achieved is clearly revealed in the map showing areal distribution of key horizons and geological structure contours published with the report. Ten domes which warranted test drilling have been mapped. Moreover, during the course of construction of the map at least three potentially productive synclines were discovered. It is, in fact, possible from a study of this report to gain a clear indication of oil and gas possibilities throughout the area, and to supplement this by reference to the records of wells in the Oriskany sandstone and in the Wayne-Dundee gas field included in the text.

Energy Balance Sheet of the Gas Engine

Under this title a series of articles was contributed to *Engineering* by Dr. F. W. Lanchester, and these have now been reprinted in pamphlet form. The author has preferred to use the term 'gas engine' rather than the more cumbersome 'internal combustion engine' for, whether the fuel be liquid or gaseous, the engine is a gas engine. An especial value is attached to this very practical exposition of the author's method of accounting for the heat available and its disposition, as it represents the fruit of many years of study of the problems involved. In discussing the debit side of the account, he claims that the lower calorific value of the fuel should be taken and also that a further initial deduction is due on account of the energy radiated by the flaming mixture to the cylinder walls. As the engine is only capable of dealing with heat, this radiant energy, which never appears as heat and is shown to be about 7 per cent of the total heat of combustion, should be initially excluded. Emphasis is laid on the advantages of conformal plotting on logarithmic paper. By this method, when absolute pressure and volume are plotted, any expression of the form, pv^{γ} = constant, is represented by a straight line the slope of which is γ, so that, for example, the diagram of the Carnot cycle for a perfect gas becomes a parallelogram easily plotted and readily interpreted. Another simplification is introduced by expressing the relation of energy to temperature in terms of "degrees of heat". The basis of the analysis is that the heat-apparent and the heat-latent are separately accounted. The former is the heat appearing in the indicator diagram, the latter is estimated from the difference deg. H − deg. T at the extreme peak of the diagram, and their sum is assumed, provisionally, to constitute the total heat supplied. The jacket loss is reckoned as that taking place prior to the instant of exhaust release, and the exhaust energy is calculated as that existing at that instant. Using deg. H as a basis, the energy balance sheet is drawn up, the estimated jacket energy being divided between flame radiation and convection loss. Referring to his method of dealing with inherent change of volume, Dr. Lanchester points out that, when applied to engines using liquid fuel, it properly points to an expansion and an increase of efficiency.

Origin of Satellites

In his paper entitled "On the Origin of Binary Stars", Dr. R. A. Lyttleton considered the rotational instability of a single body, and showed that fission takes the form of the radial ejection of a portion of the mass, the two bodies having sufficient energy to escape from each other. The principle is applied to a discussion of the satellites of the solar system (the origin of which has always been difficult to explain) in a recent paper (*Mon. Not. Roy. Astro. Soc.*, **98**, 8; June 1938). A brief mathematical investigation shows that the terrestrial planets and the satellites, assuming the temperature of the material ejected by the sun to be about 10^6–10^7 degrees C., could not have condensed, as the material would have dissipated into space. He conjectures that Jupiter and Saturn are the masses resulting from the catastrophic disruption of a single primitive planet, and as a filament of material would stream out between the components, the end portions would be captured and give rise to satellites. The other portions of the material would be able to escape from both bodies and would give rise to the terrestrial planets. When fission took place in the primitive planet, the layer of cleavage must have been as deep as the outer part of the heavy core of the planet, and this affords an opportunity for the small planets to have a difference of composition and density from those possessed by larger planets. The earth and moon came out of the catastrophe as separate bodies, and although our satellite may have been close to the earth, it never came within the Roche limit, for which reason the initial rotation period of the system could never have been less than 7·2 hours. Dealing with Uranus and Neptune, Dr. Lyttleton shows that if the fission which produced Jupiter and Saturn occurred at the distance of Uranus, escape from the system would occur. The absence of companion planets to Uranus and Neptune is, therefore, explicable on account of their great distances from the sun, and, in addition, it is suggested that these two planets represent the more massive portions of their respective primaries.

International Federation for Documentation

Conference at Oxford and London

"Documenter c'est réunir, classer et distribuer des documents de tout genre dans tous les domaines de l'activité humaine."

THE fourteenth International Conference for Documentation, which has just been held at Lady Margaret Hall, Oxford, and the Science Museum, London, under the patronage of the British Government and the presidency of Sir William Bragg, has provided a demonstration of the increasing realization of the fundamental importance of documentation in intellectual and material progress. The three hundred and fifty members of the Conference included delegates of thirty Governments and a hundred and fifty leading scientific and learned societies, research institutions, and international associations. The growing interest in the work of the Federation was reflected in the aggregate of 106 papers communicated, an increase of 150 per cent on the number presented to the Jubilee Conference of the Federation at Copenhagen three years ago. Above all, the spirit of international collaboration, which inspires the Federation, made itself felt, not only in the study of the means of co-operation in the task of making more fully available the records of human progress, but also in a remarkable feeling of international friendship and good will, which has pervaded the atmosphere of the Conference throughout its proceedings.

The Conference has demonstrated, in no uncertain manner, the intense desire of thinking men and women all over the world to collaborate in the solution of international problems, including among them the co-ordination of documentary work, as one of the most powerful means of promoting the happiness and material progress of mankind.

As Lord Stanhope remarked, in proposing the toast of the International Federation for Documentation at the Government banquet, "that is not knowledge, which we do not know where to find". Buried in books, journals, monographs, reports, patent specifications and archives, to which continual additions are being made, lie masses of invaluable data and records of advances in every field of knowledge. These facts lie hidden and inaccessible for want of a comprehensive index whereby to make them available as the basis of further progress. In the absence of such an index, incalculable time, money and labour are being wasted every day in the repetition of investigations already completed. To prevent this unnecessary delay, effort and expense is the object of the International Federation for Documentation, which seeks to unite all those engaged in the collection, classification and distribution of information, as well as everyone seriously concerned with the progress of knowledge, in the study and solution of this economic problem. The importance of such work was pointed out by Sir William Bragg in his presidential address on "The Historical Papers of the Royal Institution".

The subjects discussed in papers by leading authorities from all countries might be said to cover almost the whole field of documentation. The sessions were devoted to symposia on such subjects as: the making of abstracts from periodical literature; applications of indexing systems; the practical application and use of bibliographies; the teaching of documentation; theories of cataloguing and classification; the organization of information services; and tools for library co-operation.

Two sessions, allotted to the discussion of photographic and other technical methods in their application to bibliographical problems, and apparatus for photographic reproduction of documents, were particularly valuable, as providing the most fully representative descriptions of the latest apparatus and authoritative opinion of all countries. The exhibition arranged in the Science Museum, through the kindness of Colonel E. E. B. Mackintosh, illustrating the most up-to-date apparatus, material and methods available for the purpose, is now open to the public and should certainly be visited.

In accordance with a suggestion made at the World Congress on Documentation, held in Paris last year, that, in the past, the Federation had concentrated too exclusively on the scientific field, a special attempt was made at this Conference to include authoritative reports on the present state of bibliographical work in such fields of learning as archæology, archive work, economics, finance, history, law and painting. This led to one of the most important sessions of the Conference. Another session was devoted to a paper by Prof. A. F. C. Pollard, president of the British National Section of the Federation, on the mobilization of knowledge and the "Permanent World Encyclopædia" of Mr. H. G. Wells. Assuming that the need for such an encyclopædia has been demonstrated conclusively, Prof. Pollard gave an able survey of the reasons that have prevented the realization of this undertaking in the past, and indicated the mechanism by which these difficulties may surely and efficiently be overcome. This is a paper the value of which is likely to be more greatly appreciated with lapse of time. Mr. H. G. Wells, who was present at this sitting, made a stimulating contribution to the discussion.

The address of the president of the International Federation, Dr. Alingh Prins, on problems of international documentation, was given during the week-end, when the members of the Association of Special Libraries and Information Bureaux also were present for their annual conference and the full attendance was reached. As a clear, comprehensive and concise synopsis of the problems involved, and the simple and completely effective methods available for their solution, this paper was certainly one of the most important contributions to the Conference. Also during the joint sessions with ASLIB, Mr. E. Lancaster Jones read a useful paper on the evaluation of scientific and technical periodicals. This included suggestions of methods utilizable by libraries in choosing periodicals to take.

From the above, it will be seen that the *Transactions* of the fourteenth Conference of the Inter-

national Federation for Documentation contain perhaps the most comprehensive collection of original authoritative papers within its field, and should be studied by everyone who has at heart the mobilization of recorded information. The first issue has already been sold out. But, by the time these notes are in print, a new issue will be available at the moderate price of £1 net for the three volumes. These will be obtainable directly from the International Federation for Documentation, Willem Witzenplein 6, The Hague, or from its British National Section, British Society for International Bibliography, at the Science Library, Science Museum, South Kensington, S.W.7.

Those who are seriously interested in the task of making recorded information more fully available should put themselves in touch with Miss M. Gosset, the honorary secretary of the British Section at the above address.

Sir William Bragg's presidential address, as well as Dr. Alingh Prins' lecture as president of the Federation, together with the discussions of the papers, will be printed in the *Communicationes* published quarterly by the Federation.

Space will not permit to describe the Government banquet in the beautiful Hall of Christchurch, presided over by Lord Stanhope, the reception by the Vice-Chancellor in the Ashmolean Museum, the hospitality of the Mayor in the Town Hall, the garden party given by Dr. and Mrs. Priestley at their beautiful manor house at March Baldon, the interesting visit to Messrs. Morris Motors Ltd., the tea provided by Messrs. Kodak Ltd., and the various other visits and excursions, which did so much to create the prevailing atmosphere of friendship and provided those opportunities of social contact that constituted such a valuable part of the proceedings of the Conference.

S. C. BRADFORD.

Association of Special Libraries and Information Bureaux

Annual Conference

THE fifteenth annual conference of the Association of Special Libraries and Information Bureaux, held at Lady Margaret Hall, Oxford, on September 23–26, was somewhat overshadowed by the anxiety of the political situation, and also by the Conference of the International Federation for Documentation, which held its fourteenth annual conference simultaneously. If the joint sessions with the latter Federation unfortunately suffered from the depressing effect of an excessive number of papers which characterized the sessions of the International Federation, the remaining meetings at the ASLIB Conference had their characteristic spontaneity, and the discussion on the work of the Association at the annual meeting in particular indicated a lively interest on the part of members in its continued progress.

The president-elect, Sir William Beveridge, was unfortunately prevented by illness from giving his address on "The Use of Books in Social Science". Mr. E. W. Wignall's paper on "Museums and Research: Some Facilities in London", gave an indication of the extent to which museum officers carry out research, not only for their own departments but also for Government departments, universities and scientific institutions of different kinds all over the world. Facilities for workers not on the staff of a museum are often limited by the space available or the demands made on the time of the museum staff, and Mr. Wignall urged that in any new museum it is of the utmost importance that adequate study rooms should be provided. He also stressed the question of acknowledgment, very considerable help being sometimes given to a student which receives no acknowledgment in his subsequent papers. A brief subject list of museums in London was included in the paper.

At the annual general meeting of the Association, the honorary treasurer, Mr. A. F. Ridley, submitted accounts showing a slight balance of income over expenditure as compared with the deficit of the previous year. Although the membership of the Association has also increased from 308 to 325, the report of the Council once more emphasizes the necessity for a much larger membership if the Association is to fulfil the functions which belong to it. The report also refers to the increased circulation of the ASLIB Book-List and to the issue in May of a second edition of the "Select List of Standard British Scientific and Technical Books". Increasing use is being made of the inquiry bureau, and the panel of expert translators has been reorganized, a new register having been established under new regulations. Eighty-six members have now been enrolled under the modified scheme.

In the absence of Sir William Beveridge, Mr. B. M. Headicar presided over the evening session on September 24, when Mr. Frederick Brown, lecturer in statistics at the London School of Economics, read a paper on "The Compilation of Statistics by Trade Associations", in which his felicity and liveliness of exposition drew the warm appreciation of a large audience. Mr. Brown referred to the difficulty of generalizing about the statistics compiled or issued by trade associations owing to the wide variations in practice both in compilation and in objective or use. Terminology is also important, as frequently trade statistics cannot be interpreted without knowledge of special terms used, or of the way in which they are compiled. Among the services which trade associations can render to their members in this way is the reproduction of market prices of special interest to them in the calculation of special index numbers.

While most trade associations base their statistical work on data collected and compiled outside, some few associations are breaking fresh ground, and Mr. Brown emphasized the opportunities which await trade associations in the field of statistical research, in such matters as the compilation of figures of consumption and production by members, stocks and plant capacity and operating or production costs. In this connexion, Mr. Brown pointed out that if such work is to have any value, membership of the

association must be representative of the trade or industry as a whole, or comprise such a majority of the trade that firms who are not members are too insignificant to affect the returns.

Such statistical research could take two main forms: that of the descriptive study as seen in the survey of milk consumption in England and Wales undertaken by the Milk Board: or of the investigation type as in the survey of nutrition effects of milk also undertaken by the Milk Board; or the investigation into the causes of the marked fluctuations in retail trade about Easter and Whitsuntide undertaken by the retail distributors' associations. Mr. Brown pleaded for greater participation in such research by the universities and for greater readiness to place statistical information at the disposal of the community for the advancement of knowledge. He referred to examples of co-operation in this respect between the Retail Distributors' Association, the Bank of England and the London School of Economics, which while securing a check on possibilities of error and safeguarding the disclosure of individual sources of information, has made the collective returns accessible for research or public purposes.

At the final session on Sunday evening, Mr. Max Nicholson, secretary of Political and Economic Planning (PEP), gave an interesting account of how material for the PEP Press Report was compiled, which is of some interest to scientific workers as an example of the possibilities of the group method of inquiry and research into subjects in which very little published information is available, and especially in making available neglected experience and buried sources of information. Mr. Nicholson also stressed the value of PEP anonymity.

Society of Chemical Industry

Autumn Meeting

THE autumn meeting of the Society of Chemical Industry held in Glasgow on September 16–20 was notable for a symposium of papers on the trend of progress. The opening paper, presented for the Food Group by Dr. L. H. Lampitt, referred to the part played by chemists in the effort of nations to secure self-sufficiency, and particularly to the issues involved in the storage and preservation of food. Dr. Lampitt asserted that although internationalism in the scientific world is less pronounced, we are heading towards international agreement in certain aspects of dietetics as well as towards increased Government control of the efforts of chemists in the field of food science.

On behalf of the Road and Buildings Materials Group two papers were presented. In the first of these, Mr. R. Fitzmaurice discussed the question how far standardization and how far freedom of design are to predominate in the building industry. Referring to the accumulation of the scientific knowledge necessary to replace tradition, Mr. Fitzmaurice indicated some of the possibilities which standardization offers, given close co-operation between the architect and engineer as in the "Mapin" system of instruction. He referred also to the question of building regulations and the obstacles they sometimes present to progress whether in the introduction of new materials or new methods. Mr. Fitzmaurice referred also to the large number of British standard specifications now in existence for building materials. Many of these should provide a valuable safeguard for the purchaser in respect of particular properties of materials which constitute a source of difficulty in practice, but many architects appear to be unaware of their existence. This position, however, may slowly change through the use of these specifications in official specifications for Government or local authorities works.

The second paper, by Mr. J. O. Willis, dealing with road design, urged a trunk road policy in the construction of which full advantage could be taken of modern practice of alignment, and all interruption of the main streams of traffic obviated by overbridges and properly laid-out junctions. He stressed the importance of standards of riding quality and the improvement of surface quality, particularly of the need for the introduction of new methods of laying bituminous roads. Resistance to skidding is of vital importance, and Mr. Willis considers that asphalt surfacings, finished with precoated chippings, are only a palliative. The ideal he suggested is a fine textured bituminous carpet impervious to water and presenting a uniform texture throughout its life. In the light of work in Great Britain and in Holland, rubber might play an important part in solving the problem.

The paper presented by Dr. V. E. Yarsley on behalf of the Plastics Group referred to the fact that, in the plastics industry, only rarely has one material dominated another. This position is likely to continue, although with the balance of power inclining in favour of the thermoplastics group. The current trend is towards improved tensile properties and greater stability to heat, making possible the use of higher temperatures and the production of larger moulded units. In the field of cellulose plastics, the development of quick-growing celluloses which can be produced within Great Britain or the Empire is an obvious gain in a national emergency. Cellulose triacetate is now a commercial possibility, and ethyl-cellulose is promising for coating and impregnating compositions. The attention now being devoted to the production of shock-resisting phenolic plastics should ultimately provide an entirely new field for exploitation, while extended phenols should also do much to emphasize the possibilities of plastics as "the fourth material of construction". Aminoplastics are also promising for transparent plastics, and other possibilities lie in laminated plastics and for creaseless fabrics. The increased use of plastics for the production of high-duty wheels, gears and bearings, and also for airscrews, struts and construction parts in aircraft is only one of the developments to be expected.

In the final paper of the symposium, Prof. W. M. Cumming and Mr. F. Rumford reviewed tendencies in chemical engineering both in regard to materials

and to unit operations. In regard to the former they referred to the development of new alloys but stressed the importance of scientific comparison and selection. They referred also to the use of special steels for high-temperature and high-pressure reactions in view of the importance of creep at elevated temperatures as well as to the efforts being made to replace nickel at least in part by other metals in a number of special cast irons, and to the attention devoted to the technique of welding and the interest in organic materials such as rubber. Similarly, the authors briefly reviewed developments in heat transfer, filtration, size reduction, distillation, including the use of a true counter-current system throughout the column, evaporation, drying, dust removal and other unit operations, while in conclusion the question of education was discussed and the importance of avoiding uniformity of training was stressed.

Appropriately enough, a paper by Dr. R. Gilmour at a joint meeting with the Institution of Chemical Engineers on "Chemical Engineering in the Fermentation and Distilling Industries" had much to say about the place of art and science in the distillation of whisky, including the effect of air, water, malt and peat on the production of a high-class whisky.

Diffraction and Refraction of Radio Waves

THE increasing application to various radio purposes of ultra-short electric waves of less than 10 m. in wave-length has given a new stimulus to the problem of calculating the field strength at distances from the transmitter such that the ionosphere is of negligible influence. The solution of the problem of the diffraction of electric waves around the earth was first given on a sound basis by G. N. Watson in 1918, but this analysis involved assumptions which, while perfectly valid for the long and medium waves then in use for radio communication, are not justifiable for the ultra-short waves now being considered. For example, at long wave-lengths, the conductivity of the earth may be assumed to be infinitely great for analytical purposes, but as the wave-length is reduced through and below 10 m., the actual value of the conductivity and also the dielectric constant of the soil over which the waves are propagated has an important influence on the field strength at a distance from the source. Furthermore, the height of the receiver above the earth's surface may no longer be assumed to be a negligibly small fraction of a wave-length, when the latter is only a metre or two.

In a recent paper published by T. L. Eckersley and G. Millington (*Phil. Trans. Roy. Soc.*, A, **237**, 273–309; 1938), a phase-integral method has been applied to the problem of obtaining a formula for calculating the electric field at a distance from a wireless transmitter. This method agrees with Watson's theory in the case already considered by him, but it has the advantage that it more readily permits of extension to the case of finite earth conductivity and of an elevated transmitter and receiver. The authors claim that the phase integral method has a certain generality in exhibiting the solution as one of a general class appropriate to problems of this kind; this feature encourages the hope that other problems of the type may be solved by similar methods. The application of this analysis to the wave propagation problem has also afforded a solution to the case not considered in the original problem, but of considerable practical importance, where there is a gradient of refractive index in the atmosphere above the earth.

The paper to which reference is made above presents the detailed analysis involved in this work in a form which exhibits clearly the physical nature of the problem. Formulæ are derived from which the field strength may be obtained for any wave-length, distance from the transmitter and conductivity of the ground over which the waves travel. Furthermore, the increase of field as the receiving post is raised above the earth's surface is obtained, and by using the reciprocal theorem, the analysis applies as well to the case when the receiver is on the ground and the transmitter is elevated. By combining both cases the effect of having both the transmitter and receiver can be calculated.

A very satisfactory feature of this investigation, which will be much appreciated by those engaged in practical radio communication, is that the various formulæ have already been reduced to the computation of numerical values. A paper by T. L. Eckersley (*J. Inst. Elec. Eng.*, **80**, 286–304; 1937) gave a complete set of field strength/distance curves for wave-lengths between 2 and 10 m. and for conductivities corresponding to land and sea. Other curves provide the relationship between field-strength and height, while a simple means of extending the curves to take account of refraction through the atmosphere is explained for application when the vertical gradient of refractive index of the air is known or can be estimated. While these theoretical results await adequate experimental confirmation, they are already of considerable value as a general guide to the radio engineer; and in this case the graphs referred to above were utilized by the recent International Telecommunications Conference in Cairo in considering a preliminary allocation of bands of ultra-short waves to various classes of radio communication.

R. L. S.-R.

University Events

GLASGOW.—On September 29, the Gardiner Institute in Medicine, attached to the Western Infirmary, Glasgow, was opened by Lady Gardiner. The Institute is under the direction of the regius professor of medicine in the University, and will be devoted to clinical research. At the opening ceremony, Prof. T. R. Elliott delivered an address in which he stressed the great advantage to be derived from the establishment of such an institute, and emphasized the necessity of a closer co-operation between the science and practice of medicine.

The following appointments have recently been made in the University: Dr. O. Löwenstein to be lecturer in zoology in succession to Dr. H. B. Cott, newly appointed lecturer in vertebrate zoology, Cambridge; Mr. Vernon D. van Someren to be temporary assistant in zoology in succession to Dr. Margaret W. Jepps, who has been awarded a Leverhulme fellowship for one year.

Science News a Century Ago

The Zoological Society

AT a meeting of the Zoological Society on October 9, 1838, Richard Owen began the reading of a paper on the osteology of the Marsupialia. He remarked upon the great value of an acquaintance with the structure of the skeleton in determining the genera and species of this group of animals, and proposed a new genus *Thylacomys*, for certain species presenting a peculiar conformation of the cranium. In treating the maxillary bones, Owen said that he was induced to enter more largely into details, from the great interest attached to the fossil jaw found in the oolitic strata at Stonesfield, and the doubts which had lately been expressed by M. de Blainville as to its true mammiferous character. The author had examined four specimens, of which one was in the museum at York, another was in the collection of Mr. Broderip, and the other two were in the possession of Dr. Buckland. The double fangs to the molar teeth, and the ramus of the jaw being formed of a single bone, he thought, sufficiently attested the mammiferous nature of these remains; while minor anatomical characters led him to regard them as belonging to a marsupial genus.

Meteorological Science in Germany

WRITING from Carlsruhe, a correspondent of the *Athenæum* said: "The attention of scientific men is just now directed to a curious discovery of Professor Stiefel—well known throughout Germany for his researches in Natural Science—the result of which has been the attainment of a more accurate knowledge of those changes to which the atmosphere is subjected than was possible by the old methods. The instruments hitherto in use have been the thermometer and the barometer, but an unerring standard has been considered a desideratum: that is said to have been at last supplied in the shape of geranium fruit, the awns of which are *in* and evolved by the dryness or humidity of the atmosphere, in obedience to laws so regular and unvarying, that being fixed upon a dial plate properly graduated, the change from one part of a room to another may be noted with the greatest accuracy. A paper on the subject was to be read at the meeting of German naturalists, held this year at Freyburg. Professor Stiefel is the greatest weather doctor in southern Germany, and has for many years tabulated all changes in the atmosphere, according to a plan suggested by Goethe, but he does not venture to predict for more than twenty-four hours at a time and laughs at our weather prophets." (*Athenæum*, Oct. 13, 1838.)

New Botanic Gardens in Regent's Park

"THE interior portion of the Regent's-park," said the *Mechanic's Magazine* of October 13, 1838, "will shortly be laid out as botanical gardens, the Commissioner of Woods and Forests having granted a lease to a society newly formed under the title of the Royal Botanic Society of London, at the head of which is the Duke of Richmond as president. The object of this society is the formation of an extensive botanic garden, with a library, museum, and conservatories, so that medical and scientific as well as merely ornamental botany will respectively receive the attention commensurate with their importance."

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **207**, 353–384, August 8, 1938).

K. KITAGAWA: Dispersion of a turbulent current of air and the flow of subterranean waters.

G. BERTRAND: Principle of a method for obtaining rapidly a relative value of *g*.

G. WATAGHIN: Indeterminism in the space of moments and the origin of explosion showers.

MME. G. CHAUVENET: State of surface and oxidizability of cobalt. A fresh surface at high temperature is very vulnerable; gradually it becomes covered at lower temperatures with a thin film of unknown nature.

Y. DOUCET: Electrolytic dissociation of cadmium iodide.

D. BODROUX and A. CHATENET: Paracyclohexylphenoxyacetic acid and some of its derivatives.

M. MOUSSERON and R. GRANGER: Some active cyclohexane compounds.

C. KILIAN and X. LANGLOIS: Discovery of freshwater mussels of middle carboniferous age near the watering-place Nord de Chelemma, in the northern Toureareg-Tebou region of the French Sahara.

E. DE CHETELAT: Extension of the Gothlandian in French Guinea.

R. GUIZONNIER: Study of the diurnal component of the terrestrial electric field.

P. L. MERCANTON: The new Kreis-Wanner seismograph of the Swiss seismological service.

H. PARENT: An important bed of Bathonian ammonites in the north of the Departement of Var.

G. BOURGUIGNON and MLLE. R. DEJEAN: 'Time characteristic of excitability' of the vestibular system by mono-auricular excitation, in various disturbances of central origin.

L. LAPICQUE: Observations on the preceding communication.

F. HOLWECK: Measurement of the elementary dimensions of viruses by the method of statistical ultra-micrometry. The virus is diluted until a critical concentration, which ceases to be constantly infective, is reached, and the amount of X-ray irradiation required to match this effect is determined.

A. BESREDKA: Test of local cutaneous bacteriotherapy.

Geneva

Physical and Natural History (July 7.)

E. A. H. FRIEDHEIM: Relation between chemical constitution and trypanocidal effect of 4-(4-arsonoanilino)-1, 2-naphthoquinone-8-sulphonic acid. The naphthoquinone group is essential for therapeutic action. The presence of free hydroxyl in position 2 is important, but not essential. Sulphonation at position 8 gives a more active product than sulphonation at 7 or 6. The anilino-arsonic residue at position 4 of the acid is essential.

L.-W. COLLET: Discovery of a fragment of the San Colombano nappe under the miocene of Saint-Florent (Corsica) and its consequences. The San Colombano nappe, which is the highest in Corsica, would appear to extend into the upper tectonic element of the island with rock of a deeper facies. It is equivalent to the Ligurie nappe of the Apennines.

A. LOMBARD and W. SCHROEDER: New observations on the miocene of Saint-Florent (Corsica). The

fauna and lithological composition of the calcareous miocene forming the beach of Saint-Florent are described. The uniformity of composition of the fauna suggests stratigraphic unity, disturbed at times by submarine currents.

Moscow

Academy of Sciences (*C.R.*, **19**, No. 5, 1938).

I. M. VINOGRADOW : Some new estimations of the analytical theory of numbers.

J. LIEBERMAN : Some characteristic properties of convex bodies.

D. KOLIANKOWSKY : A theorem of O. Schmidt.

M. REBUTON : A theorem on the complexes.

S. ROSSINSKI : Deformation of a rectilineal congruence with preservation of the distributive surfaces.

S. MICHLIN : The extension of singular integration to the space α_2.

I. NATANSON : Some theorems on singular integrals.

L. PONTRYAGIN : A classification of continuous transformations of a complex into a sphere (2).

A. DONOFF : Pressures dependent upon vortex formation caused by a sudden increase in the density of the stream.

V. BOOLINSKY : Conical motion of an ideal gas in the case of a sudden increase in its density (Boosemann's problem).

P. A. WALTHER and W. A. STEFANOWSKI : Influence of the number of scoops in an axial pump on its work.

A. ALICHANIAN, A. ALICHANOV and B. DŽELEPOV : Form of the β-spectrum of radium E in the vicinity of the upper limit, and the mass of the neutrino.

A. ALICHANIAN and S. NIKITIN : Form of the β-spectrum of thorium C in the vicinity of the limit, and the mass of the neutrino.

A. ALICHANIAN, B. DŽELEPOV and P. SPIVAK : The angles between the components of a pair.

J. DORFMAN and S. SIDOROV : State of the nickel atom in the gamma phase of the Ni-Zn system.

B. KOLOMIEZ : The new 'positive' barrier plane photo-electric effect and the new barrier plane photocell.

V. FABRIKANT : Excitation of metastable atoms in a gas discharge. (2) Excitation of radiating atoms in a gas discharge.

V. FABRIKANT and G. ROKHLIN : Effect of magnetic field upon mercury discharge radiation.

E. KONDORSKY : The magnetic anisotropy of ferromagnetic crystals. (3) Reversible susceptibility of iron crystals in various crystallographic directions.

N. WASSMUTH, V. WERZNER, S. TIBILOV and S. FREIVERT : Observation on the varying intensity of the green ray in the luminosity of the night sky.

J. OLENOV and I. KHARMAC : Dynamics of the genic composition in a wild *Drosophila melanogaster* population.

G. ZABLUDA : Beheading of sunflower as a means of increasing the yield of its vegetative mass.

N. GORTIKOVA : Effect of preliminary treatment with coloured light on the development of pea-nut (*Arachis hypogaea* L.).

R. HECKER : New data on *Rhipidocystis* Jkl. (order Digitata, class Carpoidea) and on a new genus *Bockia* (sub-class Eocrinoidea, class Crinoidea) from the Ordovician of Leningrad province, U.S.S.R., and from Estonia.

R. HECKER : A new member of the class Ophiocistia Sollas (*Volchovia* n.g.) from the Ordovician of the Leningrad province, and changes in the diagnosis of this class.

S. SEMICHATOVA : Contribution to the problem of evolution of Carboniferous (Baskirian) *Choristites*.

(*C.R.*, **19**, No. 6–7).

S. ROSSINSKI : Deformation of rectilineal congruences with preservation of their distributive surfaces.

W. DUBROVSKI : A generalization of W. Feller's theory of a pure discontinuous process.

B. LEWITAN : Mean values of measurable functions.

B. FESSENKOFF : Role of the Milky Way matter in the phenomenon of the zodiacal light.

I. TCHARNYI : Calculation of chambers used for reducing pressure oscillations in the case of unsteady flow in pipes.

I. KOUKLES : On the centres and the foci.

F. S. BARYŠANSKAJA : Study of fluorescence in a layer of thickness comparable to the length of the wave. (2) Polarization of the fluorescence.

I. L. ZELMANOV : Some peculiarities observed in the liquefaction of helium.

B. KLARFELD : Influence of the Ramsauer effect on the potential gradient in a positive column.

I. TAMM : The penetrating cosmic ray particle, and nuclear forces.

V. VEKSLER and N. DOBROTIN : Heavy electrons in cosmic rays.

D. I. MIRLIS : Kinetics of wetting and selective linear corrosion of metals in polyphase systems : metal-liquid-liquid and metal-liquid-gas. (5).

V. ČELINZEV : Structure of associated molecules of organic acids on the basis of Raman spectra.

P. PETRENKO-KIRITSCHENKO and J. EKSTER : The law of periodicity.

K. TOPCHIEV : Mechanism of the formation of γ-acetopropyl alcohol during hydrogenation-hydration of α-methyl-furane and consecutive hydrogenation of the double bonds in α-methyl-furane.

G. V. GORŠKOV, N. M. LJATKOVSKAJA, A. G. GRAMMAKOV and V. S. ŽADIN : Neutrons of rocks.

V. P. BATURIN : Fluorite in the Kungurian limestones and dolomites of the Ural-Emba region.

S. I. YARJEMSKY : The rate of soil tillage.

G. MARKOV : Survival of the tapeworm plerocercoids (*Diphyllobothrium latum* L.) in artificial media.

V. I. KUDRYAVTZEV : Experimental change in the physiological properties of yeast.

V. S. LUKJANOVA : Velocity of movement of certain plankton and its dependence upon external conditions.

S. MURAVEISKY and I. CHERTOK : Carotinoids in lacustrine silts.

G. D. PRATASSENJA : Studies on polyploid plants. Parallel variation.

G. D. PRATASSENJA and E. M. TRUBITZINA : Production of polyploid plants. A triploid in *Prunus persica*.

M. R. CHEULISHVILI : Short-tailedness (brachyury) in Georgian dogs and its inheritance.

V. A. NOVIKOV : Endemic conditions of growth of *Gossypium Kirkii* Mart.

N. S. PETINOV and G. A. ZAK : Effect of hardening upon structure of the plant.

G. M. IVANOV : After-effect strain and the limit of plastic flow of wood.

A. A. WOITKEWITCH : Role of thyroid hormone in formation of feathers in fowls and pigeons.

N. N. SINAKEVITCH : Bits of liver and lung restored to life under the skin of an axolotl.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, October 10

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. Phyllis Tookey Kerridge: "The Physiology of Hearing and Speech" (succeeding lectures on October 17, 24 and 31).*

WARBURG INSTITUTE (at the Royal Society, Burlington House, W.1), at 5.30.—Prof. V. Gordon Childe: "India and the West before Darius".*

ROYAL VETERINARY COLLEGE, LONDON, at 5.30.—Prof. T. W. M. Cameron: "Principles of Parasite Control" (succeeding lectures on October 11 and 13).*

Tuesday, October 11

ROYAL SOCIETY OF MEDICINE (SECTION OF THERAPEUTICS AND PHARMACOLOGY), at 5.—Sir Frederick Banting, F.R.S.: "The Immunity Aspect of the Tumour Problem" (W. E. Dixon Memorial Lecture).

INSTITUTION OF ELECTRONICS (at King's College, Strand, London, W.C.2), at 7.30.—Dr. J. A. Darbyshire: "Applications of X-Ray Diffraction and Electron Diffraction Methods to Industrial Research".*

Thursday, October 13

INSTITUTE OF FUEL (at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1), at 2.30.—Lieut.-Colonel J. H. M. Greenly: Presidential Address.

At 3.—Prof. R. W. Wheeler: "Destructive Distillation" (Melchett Lecture).

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. R. J. Lythgoe: "The Physiology of Vision" (succeeding lectures on October 18, 20, 25 and 27).*

Friday, October 14

SCHOOL NATURE STUDY UNION (in the Conference Hall, County Hall, Westminster Bridge, London), at 6.—Autumn Meeting.

Sommerville Hastings: "The Plants of Rocks and Mountains".*

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 6.—Annual General Meeting.

Major T. Russell Cairns: Presidential Address.

Cinematograph Films: "Modern Steelcraft".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR SCIENTIFIC OFFICERS at the Ditton Laboratory, Maidstone, and the Low Temperature Research Station, Cambridge—The Establishment Officer, D.S.I.R., 16 Old Queen Street, Westminster, S.W.1 (Quote ref. J 38/12. October 12).

CHEMISTS and ASSISTANT CHEMISTS (grades II and III) under the War Department Chemist, Woolwich—The Under-Secretary of State (C.5), War Office, Whitehall, London, S.W.1 (Quote appts./101. October 22).

HEAD OF THE JUNIOR TECHNICAL SCHOOL of the Royal Technical College, Salford—The Director of Education, Education Office, Salford, 3.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Mazoe Citrus Experimental Station. Report for the Year ending 31 December 1936. (British South Africa Company, Publication No. 6.) Pp. xiii+210. (London and Salisbury, S. Rhodesia: British South Africa Co.; Mazoe, S. Rhodesia: Mazoe Citrus Estate.) [269

City of Birmingham. Annual Report of the Mental Hospitals Committee, April 1st, 1937, to March 31st, 1938. Pp. ii+35. (Birmingham: Birmingham Mental Hospital.) [269

The Vitamin Requirements of Pigs: with Special Reference to Vitamin A and to certain Components of the Vitamin B Complex. By A. S. Foot, J. Golding and S. K. Kon; with the collaboration of J. Campion, K. M. Henry and S. L. Huthnance. (N.I.R.D. Publication No. 462.) Pp. 68+10 plates. (Shinfield, Reading: National Institute for Research in Dairying.) 1*s.* 6*d.* [269

Proceedings of the Royal Irish Academy. Vol. 44, Section B, No. 11: Salmon of the River Shannon. By Arthur E. J. Went. Pp. 261–322. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 5*s.* [269

Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1938. Pp. 28+4 plates. (Kirkhill: Hannah Dairy Research Institute.) [269

Other Countries

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 107, 1ère partie: Procès-verbaux (Mai 1937). Pp. 62. 3.00 kr. Vol. 107, 2ème partie: Rapport administratif (1937–1938). Pp. 88. 3.00 kr. Vol. 107, 3ème partie: Appendices (1937–1938). Pp. 72. 3.00 kr. (Copenhague: Andr. Fred. Høst et fils.) [199

Gold Coast Colony. Report on the Gold Coast Colony for the Year April 1937 to March 1938. Pp. 17. (Accra: Government Printing Department; London: Crown Agents for the Colonies.) 1*s.* [199

Ceylon. Part 4: Education, Science and Art (F.). Administration Report of the Acting Director of the Colombo Museum for 1937. By P. E. P. Deraniyagala. Pp. F. 32. (Colombo: Government Record Office.) 35 cents. [199

Palæontologia Sinica. New Series D, No. 3 (Whole Series No. 116): The Ramification of the Middle Meningeal Artery in Fossil Hominids and its Bearing upon Phylogenetic Problems. By Franz Weidenreich. Pp. 16+6 plates. (Peiping: National Geological Survey of China.) [199

University of Illinois: Engineering Experiment Station. Circular No. 32: Two Investigations on Transit Instruments. By Prof. W. H. Rogers. Pp. 17. 25 cents. Circular No. 33: Papers presented at the Twenty-fifth Annual Conference on Highway Engineering, held at the University of Illinois, March 2–4, 1938. Pp. 162. 50 cents. Circular No. 35: Factors Involved in Plate Efficiencies for Fractionating Columns. By Prof. Donald B. Keyes. Pp. 14. 20 cents. Bulletin No. 303: Solutions for Certain Rectangular Slabs continuous over Flexible Supports. A Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in coöperation with the U.S. Bureau of Public Roads and the Illinois Division of Highways. By Prof. Vernon P. Jensen. Pp. 98. 1 dollar. Bulletin No. 304: A Distribution Procedure for the Analysis of Slabs continuous over Flexible Beams. A Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in coöperation with the U.S. Bureau of Public Roads and the Illinois Division of Highways. By Prof. Nathan M. Newark. Pp. 118. 1 dollar. (Urbana, Ill.: University of Illinois.) [269

Annual Report for the Year 1937 of the South African Institute for Medical Research, Johannesburg. Pp. 88. (Johannesburg: South African Institute for Medical Research.) [269

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1937. Pp. 29+6 plates. (Zomba: Government Printer.) 2*s.* 6*d.* [269

Third Report of the Royal Institute of Science, Bombay (1934–1937). Pp. iii+66. (Bombay: Royal Institute of Science.) [219

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 28: Sea-Surface Temperatures on some Steamer Routes in Netherlands India. Third Series: 1933–1937. By Dr. M. W. F. Schregardus. Pp. 36. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [239

An Ecological Survey of the Mountain Area of Basutoland. By R. R. Staples and W. K. Hudson. Pp. iii+68+12 plates. (Maseru, Basutoland: Comptroller of Stores; London: Crown Agents for the Colonies.) 10*s.* 6*d.* [269

Proceedings of the United States National Museum. Vol. 85, No. 3035: A Miocene Dog from Maryland. By Charles T. Berry. Pp. 159–162. (Washington, D.C.: Government Printing Office.) [269

U.S. Department of the Interior: Office of Education. Bulletin, 1938, No. 7: Curriculum Laboratories and Divisions; their Organization and Functions in State Departments of Education, City School Systems, and Institutions of Higher Education. By Bernice E. Leary. Pp. v+33. (Washington, D.C.: Government Printing Office.) 10 cents. [269

Memoirs of the Royal Asiatic Society of Bengal. Vol. 9, No. 9: Geographic and Oceanographic Research in Indian Waters. By Lieut.-Col. R. B. Seymour Sewell. Pp. 541–550. (Calcutta: Royal Asiatic Society of Bengal.) 9 annas. [269

Catalogues, etc.

Ultra Rapid Processing. Pp. 4. (London: Kodak, Ltd.)

R.M.B. Miniature Ball Bearings. (Catalogue No. 2.) Pp. 16+13. (London: Miniature Bearings, Ltd.)

Rotary Compressors and Vacuum Pumps. (ROT. 2.) Pp. 4. (London: W. Edwards and Co.)

Die Askania-Warte. Nr. 13. Pp. 24. (Berlin-Friedenau: Askania-Werke A.G.)

Catalogue of Optical Projection Apparatus. Part 1: Optical Lanterns, etc. Pp. 32. (London: Newton and Co.)

The Use of the B.D.H. Gonadotropic Hormones in the Male. Vol. 1, No. 2. Pp. 12. (London: The British Drug Houses, Ltd.)

A Catalogue of Scientific Works, including Books in Natural History, Zoology, Geology, Ornithology, Agriculture, Botany and Gardening; also Books and Periodicals on Mathematics and Physics, from the Library of the late Dr. J. R. Airey. (No. 489.) Pp. 40. (Cambridge: Bowes and Bowes.)

Spectrographic Outfits for Metallurgical and General Chemical Analyses. (S.B.107/9.) Ninth edition, completely revised. Pp. 64. Outfits for Absorption Spectrophotometry. (S.B.156/6.) Sixth edition. Pp. 64. (London: Adam Hilger, Ltd.)